4.2 WATER QUALITY

This section presents the existing environment and impacts analysis of water quality issues associated with the granting of a new lease to Equilon Enterprises LLC, dba Shell to continue to operate its Marine Terminal (Shell Terminal) in southeastern Carquinez Strait. Section 4.2.1, Environmental Setting, provides information on existing water and sediment quality in the San Francisco Bay Estuary and, in more detail, for the Project area (Suisun Bay and Carquinez Strait) as well as the immediate vicinity of the Shell Terminal and Refinery facility. Section 4.2.2, Regulatory Framework, describes the regulatory framework on a Federal, State, and local level.

Section 4.2.3, Significance Criteria, presents the significance criteria, and Section 4.2.4, Impact Analysis and Mitigation Measures, analyzes the potential Project impacts. Water quality issues associated with renewing the Shell Terminal lease include the chronic water quality impacts of continuing operations and those related to a crude oil or product spill. Operational impacts to water quality could come from the release of segregated ballast water, runoff of contaminants on the pier, the leaching of contaminants from antifouling paints or sacrificial anodes from ships visiting the terminal, the re-suspension of sediments by ship propellers and bow thrusters or by maintenance dredging, and the disposal of dredged sediments. A spill of crude oil or product could have wide ranging effects on water quality in San Francisco Bay. Section 4.2.5, Impacts of Alternatives, compares the impacts of Project alternatives, and Section 4.2.6, Cumulative Projects Impact Analysis, analyzes the impacts of cumulative projects.

4.2.1 Environmental Setting

San Francisco Bay/Estuary Regional Setting

Introduction

San Francisco Bay/Estuary is the largest estuary on the West Coast of the contiguous United States and covers an area of 450 square miles (1,166 square kilometers). The majority of San Francisco Bay is roughly parallel to the coastline in a north to south orientation, about 5 miles inland from the coastline. Several bridges span the San Francisco Bay connecting the urban areas along the edges of the San Francisco Bay. These bridges also serve as dividing lines for subregions of San Francisco Bay. South San Francisco Bay is the large area south of the Bay Bridge, while the Central Bay is a relatively smaller area between the Bay Bridge and Richmond-San Rafael Bridge. San Francisco Bay's connection to the Pacific Ocean is a small opening in the land mass at the Golden Gate. San Pablo Bay is a large area north of the Richmond-San Rafael Bridge. From San Pablo Bay, the San Francisco Bay/Estuary extends eastward through the Carquinez Strait and Suisun Bay, to the Delta of the Sacramento and San Joaquin Rivers. Central Bay is strongly influenced by the ocean, South Bay is a semi-enclosed embayment with numerous small, local freshwater inflows, and San Pablo Bay and Suisun Bay are strongly influenced by freshwater flows from the Sacramento and

San Joaquin Rivers, through the Delta, which drains about 40 percent of California's rainwater (Thompson et al. 2000). A map showing the subregions of the San Francisco Bay is presented in Biological Resources, Section 4.3.1, Environmental Setting.

San Francisco Bay is a highly industrialized and urbanized estuary with a long history of human impacts. Many contaminants in the water, sediments, and biota in various parts of the estuary have been detected at concentrations exceeding guidelines. The various embayments of San Francisco Estuary have been listed as impaired pursuant to Section 303(d) of the Clean Water Act (CWA).

Water quality of the San Francisco Bay and Estuary is affected by many factors, including:

- Geographic configuration of the San Francisco Bay and Estuary;
- Tidal exchange with the ocean;
- Freshwater inflows;
- Industrial and municipal wastewater discharges;
- Dredging and dredge material disposal;
- Runoff from highly urbanized areas adjacent to the San Francisco Bay;
- Agricultural and pasture land drainage from much of central California;
- Marine vessel discharges;
- Historic mining activities;
- Leaks and spills, and
- Atmospheric deposition.

Objectives and criteria to evaluate water and sediment quality in San Francisco Bay are presented below. Bathymetry, tidal flows, and circulation of San Francisco Bay are discussed in the physical processes section. In the next section, the various sources of contaminants are identified. Finally, general information on contaminant levels in the water and sediments of the San Francisco Bay is presented.

Objectives and Criteria

To protect beneficial uses, the Regional Water Quality Control Board (RWQCB) San Francisco Region has established objectives for waters covered by the San Francisco Basin Plan. Table 4.2-1 lists the narrative objectives for San Francisco Bay waters.

Table 4.2-1
Select Water Quality Objectives From the San Francisco Bay Basin Plan

Parameter	Objective
Bioaccumulation	Controllable water quality factors shall not cause a detrimental increase in concentrations of toxic substances found in bottom sediments or aquatic life.
Biostimulatory Substances	Waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growths cause nuisance or adversely affect beneficial uses.
Color	Waters shall be free of coloration that causes nuisance or adversely affects beneficial uses.
Dissolved Oxygen (Do)	For all tidal waters, the following objectives shall apply: in the bay, downstream of Carquinez bridge 5.0 mg/L minimum, upstream of Carquinez bridge 7.0 mg/L minimum.
Floating Material	Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses.
Oil And Grease	Waters shall not contain oils, greases, waxes, or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise adversely affect beneficial uses.
Population And Community Ecology	All waters shall be maintained free of toxic substances in concentrations that are lethal to or that produce significant alteration in population, community ecology or receiving water biota.
PH	The pH shall not be depressed below 6.5 nor raised above 8.5.
Salinity	Controllable water quality factors shall not increase the total dissolved solids or salinity of waters of the State so as to adversely affect beneficial uses, particularly fish migration and estuarine habitat.
Sediment	The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses. Controllable water quality factors shall not cause a detrimental increase in the concentrations of toxic pollutants in sediments or aquatic life.
Settleable Material	Waters shall not contain substances in concentrations that result in the deposition of material that cause nuisance or adversely affect beneficial uses.
Sulfide	All water shall be free from dissolved sulfide concentrations above natural background levels.
Suspended Material	Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.
Taste And Odor	Waters shall not contain taste- or odor-producing substances in concentrations that impart undesirable tastes or odors to fish flesh or other edible products of aquatic origin, that cause nuisance, or that adversely affect beneficial uses.
Temperature	Temperature objectives for enclosed bays and estuaries are as specified in the "Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays of California," any aquatic habitat shall not be increased by more than 5º F above natural temperatures.
Toxicity	All waters shall be maintained free of toxic substances in concentrations that are lethal to or that produce other detrimental responses in aquatic organisms.
Turbidity	Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases from normal background light penetration or turbidity relatable to waste discharge shall not be greater than 10 percent in areas where natural turbidity is greater than 50 ntu.
Un-Ionized Ammonia	The discharge of wastes shall not cause receiving waters to contain concentrations of un-ionized ammonia in excess of the following limits: annual median 0.025 mg/L, maximum (central bay and upstream) 0.16 mg/L.
Source: RWQCB (1995). Water Quality Control Plan San Francisco Bay Basin (Region 2).	

For ocean waters, the State Water Resources Control Board (SWRCB) has established objectives for the protection of aquatic life. These objectives are specified in the California Ocean Plan (SWRCB 2001). Those objectives are listed in Table 4.2-2. Water quality criteria for priority toxic pollutants for California inland surface waters, enclosed bays, and estuaries were established by the California Toxics Rule (USEPA 2000). Table 4.2-3 shows the California Toxic Rule criteria.

Table 4.2-2
California Ocean Plan Toxic Materials Limitations

Constituent	Limiting Concentrations			
	Units of Measurement	**6-Month Median**	**Daily Maximum**	**Instantaneous Maximum**
Arsenic (As)	pg/L	8	32	80
Cadmium (Cd)	pg/L	1	4	10
Chromium (Cr) (Hexavalent)	pg/L	2	8	20
Copper (Cu)	pg/L	3	12	30
Lead (Pb)	pg/L	2	8	20
Mercury (Hg)	pg/L	0.04	0.16	0.4
Nickel (Ni)	pg/L	5	20	50
Selenium (Se)	pg/L	15	60	150
Silver (Ag)	pg/L	0.7	2.8	7
Zinc (Zn)	pg/L	20	80	200
Cyanide	pg/L	1	4	10
Total Chlorine Residual	pg/L	2	8	60
Ammonia (expressed as nitrogen)	pg/L	600	2400	6000
Chronic Toxicity	Tuc		1	
Phenolic Compounds (non-chlorinated)	pg/L	30	120	300
Chlorinated Phenolics	pg/L	1	4	10
Endosulfan	ng/L	9	18	27
Endrin	ng/L	2	4	6
HCH	ng/L	4	8	12

Radioactivity: Not to exceed limits specified in Title 17, Division 1, Chapter 5, Subchapter 4, Group 3, Article 3, Section 30269 of the California Code of Regulations.
Source: SWRCB 2001. California Ocean Plan.

Table 4.2-3
California Toxics Rule Toxic Materials Concentrations for Saltwater

Constituent	Criterion Maximum Concentration (pg/L)	Criterion Continuous Concentration (pg/L)
Arsenic (As)	69	36
Cadmium (Cd)	42	9.3
Chromium (Cr)(VI)	1100	50
Copper (Cu)	4.8	3.1
Lead (Pb)	210	8.1
Mercury* (Hg)	2.1	0.025
Nickel (Ni)	74	8.2
Selenium (Se)	290	71
Silver (Ag)	1.9	
Zinc (Zn)	90	81
Cyanide	1	1
Pentachlorophenol	13	7.9
Aldrin	1.3	
gamma-BHC	0.16	
Chlordane	0.09	0.004
4,4'-DDT	0.13	0.001
Dieldrin	0.71	0.0019
alpha-Endosulfan	0.034	0.0087
beta-Endosulfan	0.034	0.0087
Endrin	0.037	0.0023
Heptachlor	0.053	0.0036
Heptachlor Epoxide	0.053	0.0036
PCB-1242		0.03
PCB-1254		0.03
PCB-1221		0.03
PCB-1232		0.03
PCB-1248		0.03
PCB-1260		0.03
PCB-1016		0.03
Toxaphene	0.21	0.0002

pg/L = micrograms per liter.
*** = National Toxics Rule 1997, not yet established by California Toxics Rule**
Source: USEPA 2000

At this time, no standards for the protection of aquatic organisms for chemical levels in sediments have been set. The NOAA has published effects-based sediment quality values for evaluating the potential for contaminants in sediment to cause adverse biological effects (Long and Morgan 1990, Long et al. 1995). These values are commonly used as guidelines to evaluate sediment contaminant concentrations. These values are referred to as Effects Range-Low (ER-L) and Effects Range-Medium (ER-M) (Long and Morgan 1990, Long et al. 1995). This tool for comparing sediment quality was developed for NOAA based on tests of toxicity of sediments to benthic organisms. In these tests, effects were rarely seen below the ER-L. Therefore, at chemical concentrations below the ER-L, effects are unlikely. Effects were usually seen above the ER-M. Thus, the ER-M is the concentration at which effects are probable. Table 4.2-4 shows these sediment criteria.

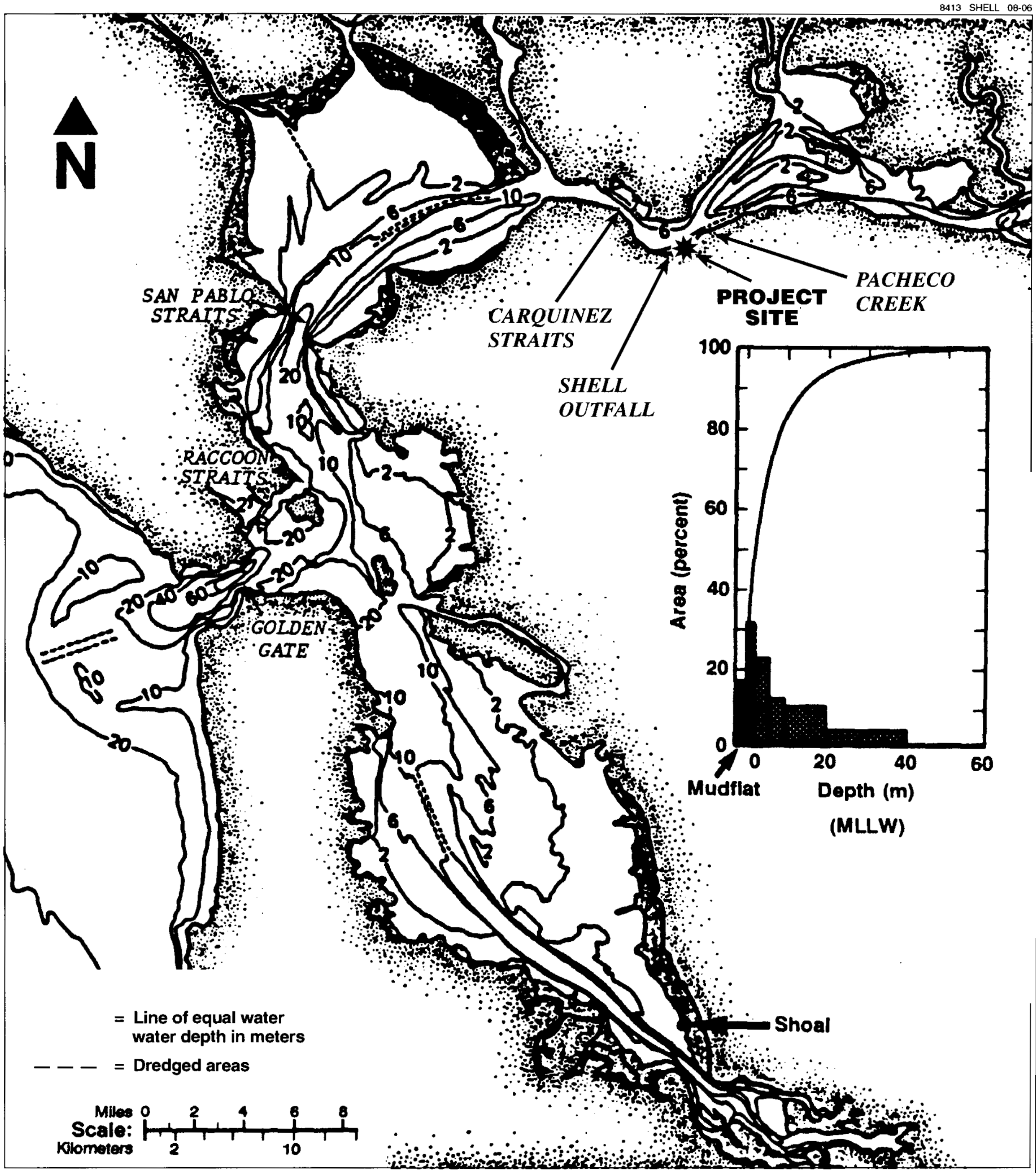
Finally, as a way of evaluating sediment contamination within San Francisco Bay, the San Francisco Estuary Institute has compiled thresholds of ambient sediment concentrations based on the cleanest portions of San Francisco Bay (Gandesbery et al. 1999). These thresholds, shown in Table 4.2-5, recognize that no part of San Francisco Bay is free of anthropogenic inputs of contaminants, but these thresholds provide a relative measure of comparing sediment contaminant concentrations within the San Francisco Bay. As shown in Table 4.2-5 even ambient metal concentrations in different size particles of sediment in San Francisco Bay exceed the ER-L concentration for arsenic, chromium, mercury, and total DDT. Sediments with greater than 40 percent fine content exceed the ER-L for copper, acenaphthylene, anthracene, fluorene, and high molecular weight polycyclic aromatic hydrocarbons (PAHs). Both fine and coarser sediments exceed the ER-M for nickel.

Physical Processes

San Francisco Bay has complex bottom topography with broad shallow embayments that are incised by a deeper channel, channel constrictions between the embayments, and connection to the Pacific Ocean through a deep narrow entrance at the Golden Gate. Depth contours for San Francisco Bay are shown on Figure 4.2-1. Water depths in San Francisco Bay range from zero to greater than 330 feet (100 m) at the entrance to the Bay at the Golden Gate. The deeper portions of the San Francisco Bay are along the west side of Central Bay. The strong tidal currents in Central Bay result in significant sand waves along the bottom that have heights of 7 to 10 feet.

Much of the San Francisco Bay is relatively shallow. Approximately half the surface area of the San Francisco Bay has water depths less than 7 feet (2 m) below MLLW when intertidal mudflats are included in the definition of the surface area (Conomos et al. 1985). The 33-foot (10-meter-depth) contour extends about a third of the way into South San Francisco Bay. Dredging of a narrow channel has extended this contour through South San Francisco Bay. The 33-foot (10-meter-depth) contour extends northward to Carquinez Strait in a fairly narrow shipping channel. Depth contours in San Francisco Bay/Estuary are very important because they direct the strong tidal flow in the Bay.

Figure 4.2-1 – Depth Contours for San Francisco and San Pablo Bays and Carquinez Straits



Chambers Group

DEPTH CONTOURS FOR SAN FRANCISCO AND SAN PABLO BAYS AND CARQUINEZ STRAITS
Figure 4.2-1

Table 4.2-4
Sediment Effects Guideline Values

Parameter	Effects Range-Low (ER-L)	Effects Range-Median (ER-M)
Metals (mg/kg)		
Antimony (Sb)	2.0	2.5
Arsenic (As)	8.2	70
Cadmium (Cd)	1.2	9.6
Chromium (Cr)	81	370
Copper (Cu)	34	270
Lead (Pb)	46.7	218
Mercury (Hg)	0.15	0.71
Nickel (Ni)	20.9	51.6
Silver (Ag)	1	3.7
Zinc (Zn)	150	410
Organics (µg/kg)		
Acenaphthene	16	500
Acenaphthylene	44	640
Anthracene	85.3	1100
Fluorene	19	540
2-Methyl naphthalene	70	670
Naphthalene	160	2100
Phenanthrene	240	1500
Low-molecular weight PAH	552	3160
Benz(a)anthracene	261	1600
Benzo(a)pyrene	430	1600
Chrysene	384	2800
Dibenzo(a,h)anthracene	63.4	260
Fluoranthene	600	5100
Pyrene	665	2600
High molecular weight PAH	1700	9600
Total PAH	4022	44792
p,p'-DDE	2.2	27
Total DDT	1.58	46.1
Total PCBs	22.7	180

ER-L = Concentration at lower tenth percentile at which adverse biological effects were observed or predicted.
ER-M = Concentration at which adverse biological effects were observed or predicted in 50% of test organisms.
mg/kg – milligrams per kilogram.
µg/kg – micrograms per kilogram
Source: Long et al. 1995.

Table 4.2-5
Sediment Thresholds for San Francisco Bay

Analyte	SF Estuary Sediment Ambient Concentration (dry wt.) [p=.85]		ERL[1] (dry wt.)	ERM[2] (dry wt.)
	<40 % fines	40-100 % fines		
Metals (ppm) (HNO3/HCl Digestion)				
Arsenic (As)	13.5	15.3	8.2[1]	70[2]
Cadmium (Cd)	0.25	0.33	1.2	9.60
Chromium (Cr)	91.4	112	81	370
Copper (Cu)	31.7	68.1	34	270
Lead (Pb)	20.3	43.2	46.7	218
Mercury (Hg)	0.25	0.43	0.15	0.71
Nickel (Ni)	92.9	112	20.9	51.6
Selenium (Se)	0.59	0.64		
Silver (Ag)	0.31	0.58	1	3.7
Zinc (Zn)	97.8	158	150	410
Organic Compounds (ppb)				
Chlordanes, total	0.42	1.1		
Dieldrin	0.18	0.44		
HCH, total	0.31	0.78		
HCB, total	0.19	0.48		
DDTs, total 6 isomers	2.8	7	1.58	46.1
PCBs, total	5.9	14.8	22.7	180
PCBs, total (SFEI 40 list)	8.6	21.6		
1-Methylnaphthalene	6.8	12.1		
1-Methylphenanthrene	4.5	31.7		
2,3,5-Trimethylnaphthalene	3.3	9.8		
2,6-Dimethylnaphthalene	5	12.1		
2-Methylnaphthalene	9.4	19.4	70	670
Acenaphthene	11.3	26.6	16	500
Acenaphthylene	2.2	31.7	44	640
Anthracene	9.3	88	85.3	1,100
Benz(a)anthracene	15.9	244	261	1,600
Benzo(a)pyrene	18.1	412	430	1,600
Benzo(b)fluoranthene	32.1	371		
Benzo(e)pyrene	17.3	294		
Benzo(g,h,i)perylebe	22.9	310		
Benzo(k)fluoranthene	29.2	258		
Biphenyl	6.5	12.9		
Chrysene	19.4	289	384	2,800
Dibenz(a,h)anthracene	3	32.7	63.4	260
Fluoranthene	78.7	514	600	5,100
Fluorene	4	25.3	19	540
Indeno(1,2,3-c,d)pyrene	19	382		
Naphthalene	8.8	55.8	160	2,100
Perylene	24	145		
Phenanthrene	17.8	237	240	1,500
Pyrene	64.6	665	665	2,600
High molecular weight PAHs, total	256	3,060	1,700	9,600

Table 4.2-5 (continued)
Sediment Thresholds for San Francisco Bay

Analyte	SF Estuary Sediment Ambient Concentration (dry wt.) [p=.85]		ERL[1] (dry wt.)	ERM[2] (dry wt.)
	<40 % fines	40-100 % fines		
Low molecular weight PAHs, total	37.9	434	552	3,160
PAHs, total	211	3,390	4,022	44,792

[1] **ER-L = Effects Range Low.**
[2] **ER-M = Effects Range Median.**
Source: Gandesbery et al. 1999

Water quality of San Francisco Bay is greatly affected by tidal exchange with the Pacific Ocean through the Golden Gate. The average tide range for the San Francisco Bay Area is about 5 feet of elevation change. With the large surface area of San Francisco Bay, this results in extremely large volumes (50 x 10^9 cubic feet, or 1 million acre feet) of water flowing into and out of the San Francisco Bay every 6 hours with the change of tides. The bottom contours of the San Francisco Bay direct the flow of the flooding tide into North and South San Francisco Bay. Large eddies are created in Central San Francisco Bay by the tidal exchange. Waters from the Pacific Ocean are generally saltier and cooler than the waters in San Francisco Bay, and thus the tidal exchange is generally in the deeper waters of the San Francisco Bay.

San Francisco Bay (especially the Northern Reach of San Pablo Bay, Carquinez Strait, Suisun Bay and the Delta) is strongly influenced by freshwater flows. The Sacramento and San Joaquin Rivers are the largest sources of fresh water, contributing on average 19.3 and 3.4 million-acre-feet per year, respectively. The volume and timing of these freshwater inflows vary dramatically from year to year depending on the amount of rain and snowfall. The highest inflows usually occur between November and May. This fresh water is generally warmer than the ocean water, and with its low salinity, is less dense than seawater. Summers are generally dry with little rain or runoff.

Circulation and mixing are relatively complicated in San Francisco Bay because of the complex geometry and variable amount of freshwater flow during the year. The circulation of water in the San Francisco Bay is driven primarily by tides, and to some extent, by wind-induced currents and estuarine circulation.

Tides are responsible for most of the water motion in the San Francisco Bay. They are the dominant force for mixing and contribute greatly to the dispersion of material. However, tidal motion is oscillatory and consequently contributes proportionally little to the net transport of material out of the San Francisco Bay (Davis 1982). Net transport out of the San Francisco Bay is equivalent to freshwater flows into the San Francisco Bay (including publicly owned treatment works [POTW] and industrial discharges) and the amount of new ocean water introduced by tides. Freshwater flows into the San Francisco Bay from the Delta result in estuarine circulation that is driven by the density difference between freshwater and saline ocean water. These flows vary greatly with location in the San Francisco Bay and the amount of freshwater input. Vertical stratification of water quality parameters in the San Francisco Bay also varies substantially depending on the location and the amount of the freshwater flows.

During the winter, the water residence time is approximately 2 weeks for the northern reaches of the San Francisco Bay, while in southern portions of the San Francisco Bay residence times are approximately 2 months. During the summer, water residence time is 2 months for the northern reaches of the San Francisco Bay, while in the southern portions of the San Francisco Bay residence times are 5 months (Conomos 1979).

Wind mixing, like tidal mixing, contributes greatly to local mixing, but contributes very little to net flow of fluids, sediments, and pollutants out of the San Francisco Bay.

Sources of Pollutants to San Francisco Bay/Estuary

The largest sources of pollutant input to San Francisco Bay are nonpoint discharges including urban and non-urban runoff and inputs from rivers. Urban runoff is the water from urban areas that flows into the Estuary from streams and storm drains. It includes rainwater, excess irrigation flows, and water used for washing down sidewalks and parking lots.

Sources of pollutants in urban runoff are extremely varied and include commercial, industrial, and residential land uses, as well as pollutants from managed open space areas such as parks, cemeteries, planted road dividers, and construction sites. Human activities in these areas, such as the application of pesticides and fertilizers to gardens and landscaping, operation of motor vehicles, and construction of roads and buildings, all contribute pollutants to urban runoff.

A recent study of contaminant loads from stormwater to the San Francisco Bay region indicated that residential areas appeared to be a large contributor to all of the metals found to be contaminating water quality (Davis et al. 2000). Commercial and industrial areas generate substantial loads of phosphate, cadmium, lead, zinc, and other contaminants.

Non-urban sources of nonpoint pollution include runoff agricultural lands, forests, pastures, and natural range, and are contributed to the San Francisco Bay by rainfall runoff, excess irrigation return flows, and subsurface agricultural drainage. Pollutants of concern in non-urban runoff include trace elements, synthetic organic pollutants (particularly pesticides), and solvents used for pesticide application.

The Sacramento and San Joaquin Rivers are the major rivers that discharge into San Francisco Bay. These rivers receive drainage from almost 40 percent of the land area of California and drain California's major agricultural region, the Central Valley. Contaminant loading from rivers is considered to be significant for mercury, selenium, nickel, silver, and registered pesticides and possibly may be significant for PCBs, PAHs, copper, and cadmium (Davis et al. 2000).

San Francisco Bay/Estuary receives inputs from industrial and municipal discharges. The San Francisco Bay receives treated wastewater from several municipal discharges that serve the large metropolitan areas surrounding the San Francisco Bay. Municipal discharges are the largest point source discharges to San Francisco Bay. Permitted dry weather flow is 565 million gallons/day (mgd) for municipal discharges to San Francisco Bay (RWQCB 1995). The average dry weather flow is less than this maximum permitted amount. The largest municipal discharger is the San Jose/Santa Clara Water Treatment Plant with an average daily discharge volume of about 133 mgd (Davis et al. 2000). The major industrial dischargers are oil refineries such as the Chevron Richmond refinery in Central Bay. Effluent discharges are considered currently to be a significant pathway for two high priority contaminants, selenium and organophosphate pesticides (Davis et al. 2000).

Every year, an average of 6 mcy of sediments must be dredged from shipping channels and related navigation facilities throughout San Francisco Bay. In the past, the majority (80 percent) of dredged material was disposed at designated sites in the San Francisco Bay. Today, three in-Bay disposal sites are designated for multiple users: the Carquinez Strait, San Pablo Bay, and Alcatraz Island disposal sites. The Alcatraz site is the most heavily used of the in-Bay sites, receiving up to 4 mcy of sediment per year from Central and South Bay dredging projects. Another 1 to 2 mcy of dredged material per year is disposed at the Carquinez Strait site, and up to 0.5 mcy at the San Pablo Bay site. Two additional aquatic disposal sites, the Suisun Bay site and the San Francisco Bar Channel site just outside the Golden Gate, are restricted to disposal of clean sand from USACE maintenance dredging projects. The LTMS for Placement of Dredged Material in the San Francisco Bay Region calls for a balanced upland/wetland reuse and ocean disposal (USACE et al. 1998). This preferred alternative includes low in-Bay disposal (approximately 20 percent compared to the present 80 percent), medium ocean disposal (approximately 40 percent), and medium upland/wetland reuse (approximately 40 percent). The transition from in-Bay disposal to beneficial use of dredged material will be achieved gradually over a 12-year transition period (USACE, USEPA, BCDC, and SWBRWQCB 2001). The 12-year transition begins with an overall in-Bay disposal volume of 2.8 mcy plus a contingency volume (for unforeseen events) of up to 250,000 cubic yards. During this period, the volume of material allowed for in-Bay disposal will decrease by 387,500 cubic yards every 3 years. Dredged material disposal is considered to be a minor pathway for the loading of contaminants to San Francisco Bay (Davis et al. 2000). Copper is the only contaminant where this pathway may be significant.

Marine vessels are also sources of various pollutants to the estuary. The discharge of untreated sewage and gray water from commercial and recreational vessels has caused concern in various parts of the estuary. Vessel discharges, including release of bilge waters, are prohibited within the San Francisco Bay. However, an unknown amount of waste is believed to be illegally discharged directly into estuarine waters. This type of effluent contributes coliform bacteria, biochemical oxygen-demanding substances, nutrients, oil and grease, and suspended solids. In addition, the discharge of ballast water from large commercial vessels has introduced exotic species of aquatic organisms into the estuary. The introduction of exotic species via ship's ballast water has severely disturbed the aquatic communities of San Francisco Bay. The problems of exotic species introductions are discussed in detail in Section 4.3, Biological Resources. Accidental spills of petroleum products from ships are generally small and result from operator errors, handling accidents at terminals, and damage to ships, but these add to chronic pollution. Tanker accidents have resulted in major oil spills in San Francisco Bay.

Contaminants in the atmosphere deposit traces on both land and water surfaces. Deposition to the land results in transfer to the Bay in stormwater runoff. Available information suggests that direct atmospheric deposition may be a significant pathway for loading of dioxins, PAHs, PCBs, and mercury (Davis et al. 2000).

Water and Sediment Quality in San Francisco Bay

The San Francisco Estuary Regional Monitoring Program for Trace Substances (RMP) began in 1993 to monitor pollutants in the estuary. The RMP is funded by 74 local, State, and Federal agencies and companies through their discharge or Bay use permits to monitor water and sediment quality at sites located throughout San Francisco Bay (Thompson et al. 2000). In 2002 the RMP switched from the 24 designated stations to a stratified random sampling scheme (San Francisco Estuary Institute 2005). Water and sediment samples are randomly allocated into five hydrogeographic regions of the estuary. These regions are Suisun Bay, San Pablo Bay, Central Bay, South Bay, and Lower South Bay. Typically in any given year a substantial number of locations within the San Francisco Bay will have water or sediments that exceed criteria for one or more metals. Central Bay tends to have the lowest concentrations of metals. Organic contaminants frequently exceeding criteria in San Francisco Bay samples include DDTs in water samples and PAHs, PCBs, and DDTs in sediment samples.

In 2002 and 2003 concentrations of most metals and organic contaminants in the water column were highest in the southern regions of San Francisco Estuary (San Francisco Estuary Institute 2005). Much of the South Bay and Lower South Bay lie adjacent to watersheds with regions of urbanization, agriculture, and historic mercury mining. The southern reach also receives treated wastewater effluent from three municipal treatment facilities. With the exception of copper in the South Bay, all regions of the San Francisco Bay were below California Toxic Rule thresholds for dissolved metals and PAHs in 2003 (San Francisco Estuary Institute 2005). On the other hand, in 2003 all regions of the San Francisco Bay were above the California Toxics Rule threshold for protection of human health for total PCBs. In 2003 the highest sediment contaminant concentrations were measured at stations in San Pablo Bay, Central Bay, and lower South Bay.

RMP sampling of fish tissue in San Francisco Bay has indicated that humans may be at risk of exposure to chemicals through consumption of contaminated fish (Thompson et al. 2003, Greenfield et al. 2000). In 1997, mercury exceeded a human health screening value in 44 of 84 samples of fish tissue in the San Francisco Bay, and PCBs exceeded human health screening values in 51 of 72 samples of San Francisco Bay fish tissue (Thompson et al. 2003). Other chemicals that exceeded human health screening values in some samples of San Francisco Bay fish tissue included dieldrin, DDTs, chlordanes, dioxin, and dibenzofuran.

In 2000, the RMP analyzed mercury, selenium, and trace organic contaminant concentrations in seven sport fish species from San Francisco Bay (Greenfield et al. 2003). As in previous sampling, fish samples exceeded human health screening values for most monitored contaminants. With the exception of chlordanes, every contaminant sampled in finfish in 2000 exhibited some screening value exceedances. Screening values were exceeded for PCBs, dioxin toxic equivalents, mercury, dieldrin, selenium and DDTs. Many fish samples also contained detectable residues of the flame retardant compounds, PBDEs. PCB concentrations exceeded the screening value in almost every fish sampled. In general, Oakland and South Bay Bridges were relatively high in contaminant concentrations while Berkeley and San Pablo Bay were relatively low.

Clam and crab samples also were analyzed in the 2000 study. For most contaminants clam tissue and crab muscle tissue had lower concentrations than monitored sport fish, indicting that consumption of these shellfish is not as significant an exposure route to humans as are monitored sport fish.

Project Area (Carquinez Strait and Suisun Bay)

Physical Characteristics

The detailed Project area encompasses Carquinez Strait and Suisun Bay. The study area extends from the Carquinez Bridge (Interstate 80) to the western edge of the legally defined Delta, just west of Pittsburg. Carquinez Strait and Suisun Bay are strongly influenced by flows from the Sacramento and San Joaquin Rivers. The response to high river flows is nearly instantaneous in the Project area. The responses to high river inflow includes rapid dilution of surface salinity and a large increase in total suspended solids especially during the first large pulse of river flow each year (Cloern et al. 1999).

Carquinez Strait is a deep (mean depth 29 feet), narrow, 12-mile-long waterbody that joins San Pablo Bay with Suisun Bay. The Strait is characterized by a variable salinity regime resulting from fluctuations in freshwater flow from the Sacramento-San Joaquin river system (USACE, EPA, BCDC, RWQCB, and SWRCB 1998). The narrow restriction of the Strait results in strong currents and consequently most of the bottom is sandy substrate. Water in Carquinez Strait is stratified into a two-layer flow, with lighter freshwater moving seaward in the top layer and heavier saltwater moving upstream on the bottom (San Francisco Estuary Project 1997). This two-layer flow, known as gravitational circulation, is strong in Carquinez Strait except during extremely high outflows when waters in the Strait are completely fresh (San Francisco Estuary Project 1997, Schoellhamer and Burau 1998).

Suisun Bay is a shallow embayment between Chipps Island, at the western boundary of the Delta, and the Benicia-Martinez Bridge. Suisun Bay covers approximately 36 square miles, has a mean depth of 14 feet, and a mean salinity of approximately 7 parts per thousand (ppt) (USACE, EPA, BCDC, RWQCB, and SWRCB 1998). Freshwater from the Sacramento and San Joaquin Rivers usually meets saltwater from the ocean in the vicinity of Suisun Bay. The bottom of Suisun Bay is predominantly fine silt and clay, crossed by channels scoured by tidal and riverine flows. The surficial sediments around these channels change according to season (USACE, EPA, BCDC, RWQCB, and SWRCB 1998). High riverine flows winnow the fine sediment of Suisun Bay and transport it downstream through Carquinez Strait and into San Pablo Bay. As riverine flows decrease, silt is deposited in Suisun Bay and the surficial sediments again become fine silt and clay.

A biologically significant area of high particle concentration, known as the entrapment zone, typically is located in Suisun Bay. Increasing river flows push the entrapment zone seaward and decreasing river flows allow the entrapment zone to move landward (Schoellhamer and Burau 1998). The entrapment zone is an area of high productivity where nutrients and organisms accumulate and is considered to be important to many aquatic species in San Francisco Estuary. The entrapment zone tends to occur where the surface salinity is between 1 and 6 ppt (Schoellhamer and Burau 1998).

The entrapment zone was formerly believed to occur in the vicinity of the null zone, the location where landward- and seaward-flowing bottom currents converge. Recent studies have shown that the position of the null zone is controlled partly by the movement of the salt field and partly by the bathymetry of the estuary (San Francisco Estuary Project 1997, Schoellhamer and Burau 1998). A semi-permanent null zone occurs near the Benicia Bridge, where the change in depth produces upwelling and a maximum in turbidity. Null zones also may occur in the northwest end of Suisun Bay along the mothball fleet, east of the Suisun Cutoff and in the lower Sacramento River, whenever the salinity is above 2 ppt at these locations. Consequently, the null zone is not necessarily located in the same position as the entrapment zone. The complex interactions between movement of the salt field, gravitational circulation, and retention of particles and organisms in the entrapment zone is the focus of much current research.

The amount of Delta runoff greatly affects water column characteristics in the Project area and results in a great variance in water quality conditions from year to year. The amount of Delta outflow determines water mass characteristics for much of the Project area. Table 4.2-6 shows the water column characteristics for 1999 through 2001 at RMP Station BF-10 at Pacheco Creek approximately 2 miles east of the Shell Terminal. This station is the closest RMP monitoring station to the Shell Terminal. In 2002 the set stations were replaced by a stratified random approach. At the Pacheco Creek station, nutrients and chlorophyll-A were slightly on the low side compared to other stations in San Francisco Bay. Dissolved oxygen from 1999 and 2001 was always well above the 5 miligrams per liter (mg/L) considered the minimum oxygen concentration to support aquatic life. Salinity varied from 0 during spring periods of high river outflow to as much as 10.4 ppt during summer. Temperature varied from 9.5 degrees Centigrade in February of 1999 to 21.5 degrees Centigrade in August of 2001.

Table 4.2-6
Water Column Characteristics of Station BF 10 – Pacheco Creek

Parameter	2/99	4/99	7/99	2/00	7/00	2/01	8/01
Ammonia (mg/L)	0.11	0.07	0.04	0.13	0.09	0.20	0.11
Chlorophyll-a (mg/m^3)	2.3	5.1	1.6	1.7	1.3	1.2	2.0
Dissolved Oxygen (mg/L)	10.7	9.7	8.5	9.1	8.3	11.1	8.8
Nitrate (mg/L)	0.35	0.26	0.51	0.333	0.431	0.51	0.48
Nitrite (mg/L)	0.009	0.011	0.004	0.017	0.012	0.020	0.025
Phosphate (mg/L)	0.14	0.02	0.09	0.058	0.081	0.07	0.12
Salinity (by Salinometer) (psu)	ND	ND	6.4	ND	6.7	7.9	10.4
Temperature (°C)	9.4	15.9	19.6	11.9	19.2	9.6	21.5

ND = Not Detected.
Source: SFEI 2001

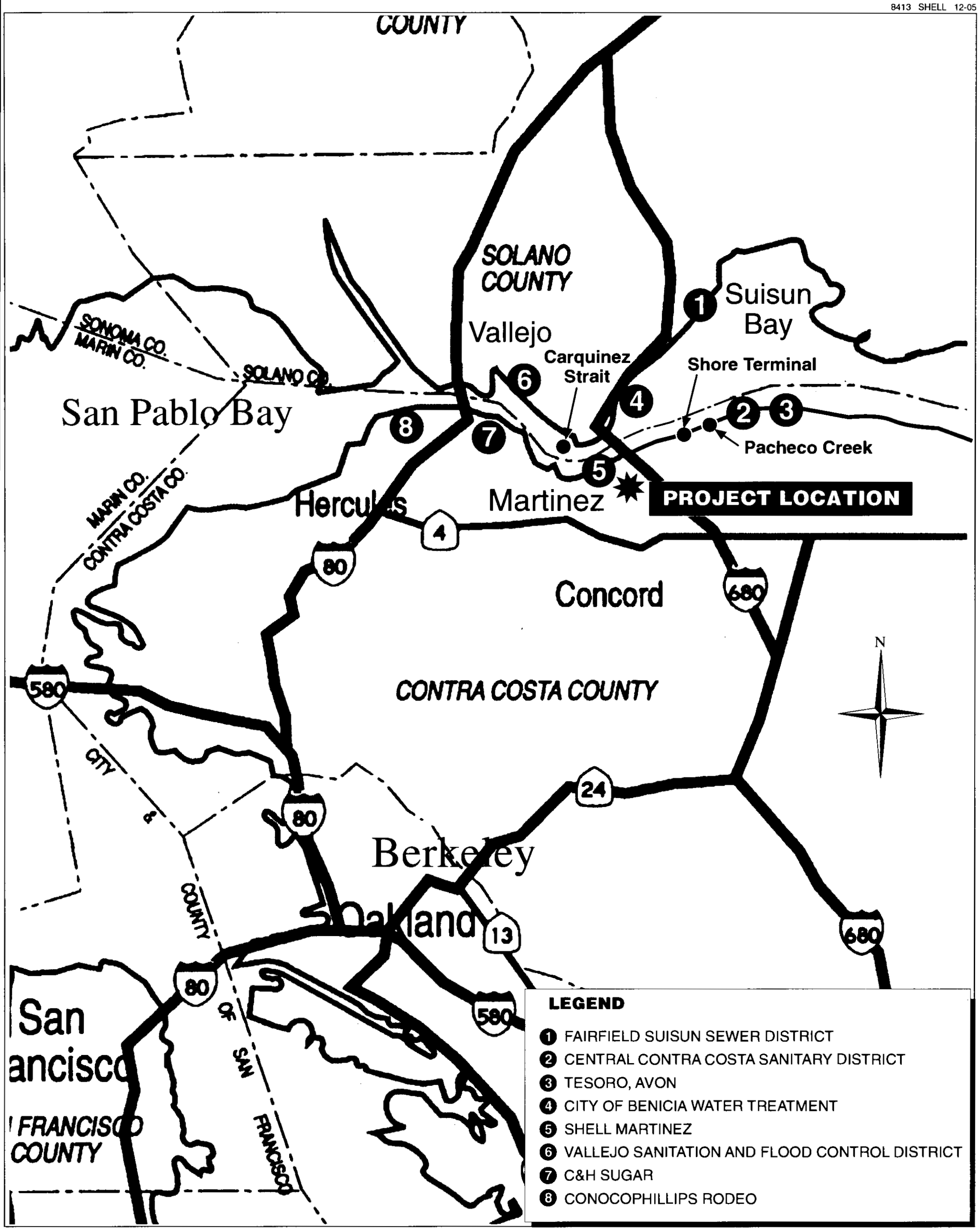
Water Quality

The San Francisco Bay Basin Plan designates beneficial uses for water bodies covered by the plan (RWQCB 1995). Designated beneficial uses for waters in the Project area (Carquinez Strait and Suisun Bay) include ocean commercial and sport fishing, estuarine habitat, industrial service supply, fish migration, navigation, preservation of rare and endangered species, water contact recreation, non-contact water recreation, fish spawning, and wildlife habitat.

The Project area, including both Carquinez Strait and Suisun Bay, is on the California 303(d) list of impaired water bodies for a variety of pollutants (Table 4.2-7). Carquinez Strait and Suisun Bay are on the 303(d) list for chlordane, DDT, diazinon, dieldrin, dioxins, exotic species, furan compounds, mercury, PCBs, and selenium (SWRCB 2002). Suisun Bay also is on the list for nickel.

The greatest source of contaminant input to the Project area is nonpoint agricultural runoff into the Sacramento and San Joaquin Rivers. Other local contaminant sources include municipal and industrial dischargers, dredged material disposal, storm runoff, atmospheric deposition, and vessels. Figure 4.2-2 shows major permitted point source dischargers in the Project area. Of these, the Central Contra Costa Sanitary District with an average discharge of 52 mgd is by far the largest point source discharger to the Project area (Davis et al. 2000). The second and third largest dischargers are the Fairfield Suisun Sewer District and the Vallejo Sanitation and Flood Control District, which discharge 17 mgd and 14 mgd respectively to Project area waters. All the other permitted point source dischargers to the Project area discharge less than 10 mgd each.

Figure 4.2-2 – Major Point Source Dischargers in Project Area



MAJOR POINT SOURCE DISCHARGES IN PROJECT AREA
Figure 4.2-2

Chambers Group

Table 4.2-7
Carquinez Strait and Suisun Bay Pollutants, Total Maximum Daily Load (TMDL) Priority and Sources of Pollutants in the 2002 California 303(d) List of Impaired Waterbodies

Pollutants/Stressors	Priority	Source
Chlordane (listed by EPA)	Low	Nonpoint Source
DDT	Low	Nonpoint Source
Diazinon (Diazinon levels cause water column toxicity. Two patterns: pulses through riverine systems linked to agricultural application in late winter and pulses from residential land use areas linked to homeowner pesticide use in late spring, early summer. Chlorpyrifos may also be the cause of toxicity; more data needed, however.)	Low	Nonpoint Source
Dieldrin (listed by EPA)	Low	Nonpoint Source
Dioxin Compounds (listed by EPA)	Low	Atmospheric Industrial Deposition
Exotic Species (disrupt natural benthos; change pollutant availability in food chain; endanger food availability to native species.	Medium	Ballast Water
Furan Compounds (listed by EPA)	Low	Atmospheric Deposition
Mercury (Hg) (current data indicate fish and wildlife consumption impacted uses. Major source is historic; gold mining sediments and local mercury mining; most significant ongoing source is erosion and drainage from abandoned mines; moderate to low level inputs from point sources.)	High	Industrial Point Sources Municipal Point Sources (Carquinez Strait only) Resource Extraction Atmospheric Deposition Natural Sources Nonpoint Source
Nickel (Ni) (listed by EPA) – Suisun Bay only	Low	Unknown Source
PCBs (non dioxin-like) (interim health advisory for fish; uncertainty regarding water column concentration data.)	High	Unknown Nonpoint Source
PCBs (dioxin-like) (listed by EPA)	Low	Unknown Nonpoint Source
Selenium (Se) (affected use is one branch of the food chain; most sensitive indicator is hatchability in nesting diving birds, significant contributions from oil refineries (control program in place) and agriculture (carried downstream by rivers); exotic species may have food chain more susceptible to accumulation of selenium; health consumption advisory in effect for scaup and scoter (diving ducks); low TMDL priority because Individual Control Strategy in place.)	Low	Industrial Point Sources Agriculture Natural Sources (Suisun Bay only)
Source: SWRCB 2003		

There are two dredged material disposal sites in the Project area. The Carquinez Strait disposal site (known as "SF-9") is a 1,000-foot by 3,000-foot rectangle located 0.9 mile west of the entrance to Mare Island Strait at the western end of Carquinez Strait (USACE, EPA, BCDC, RWQCB, and SWRCB 1998). The bulk of the material discharged at this site comes from dredging of the Mare Island Ship Channel. The current disposal volume limitation on this site is 2 to 3 mcy, depending on whether the year is a "normal" or "wet" year respectively. A tracer study done at this site indicated that about 10 percent of the sediment discharged at this site recycled back into Mare Island Strait, while the rest dispersed across a large portion of San Pablo and Suisun Bays (USACE, EPA, BCDC, RWQCB, and SWRCB 1998). The Suisun Bay disposal site (known as "SF-8") is a 500-foot by 11,200-foot rectangle located along the northern side of the Suisun Bay Channel just offshore from the Shore Terminals pier (USACE, EPA, BCDC, RWQCB, and SWRCB 1998). This site is limited to Federal project use for materials that are at least 95 percent sand from maintenance dredging of the Suisun Bay Channel. The current disposal volume limitation at the Suisun Bay disposal site is 0.2 mcy.

Concentrations of trace metals in RMP water samples in North Bay are generally considerably higher than in Central Bay, but lower than in South Bay (San Francisco Estuary Institute 2001). The exception to this pattern is chromium. The North Bay tends to have higher water column levels of chromium than Central Bay or South Bay. Table 4.2-8 shows the most recent trace metal data for RMP station BF-10 at Pacheco Creek. The Pacheco Creek station is the RMP station closest to the Shell Terminal. Some of the samples at this station exceeded Water Quality Criteria (WQC) for chromium, copper, mercury, and nickel. With the exception of one high value of chromium (122.18 ug/l[Micrograms per liter]), concentrations of other metals at Pacheco Creek were generally close to the means for North Bay. Starting in 2002, the RMP changed to stratified random sampling rather than sampling of set stations.

Table 4.2-8
Total Trace Elements in Water Samples From
Station BF 10 – Pacheco Creek

Total Trace Metals (ug/L)	2/99	4/99	7/99	2/00	7/00	2/01	8/01
Ag (Silver)	0.007	0.008	0.009	NA	NA	NA	NA
As (Arsenic)	1.8	1.79	2.8	2.28	3.41	2.91	3.04
Cd (Cadmium)	0.024	0.041	0.043	NA	NA	NA	NA
Cr (Chromium)	7.03	20.99	**122.18**	NA	NA	NA	NA
Cu (Copper)	**4.4**	**8.1**	**4.3**	NA	NA	NA	NA
Hg (Mercury)	0.01	**0.0286**	0.0105	0.0162	NA	NA	0.0167
Ni (Nickel)	**8.5**	**13**	5.5	NA	NA	NA	NA
Pb (Lead)	1.15	2.67	0.92	NA	NA	NA	NA
Se (Selenium)	0.09	0.05	0.22	ND	0.129	0.21	0.19
Zn (Zinc)	6	17.3	5.8	NA	NA	NA	NA

NA = Not Analyzed/Not Available. ND= Not Detected.
Bold= Exceeds California Toxics Rule criteria
Source: SFEI 2001

In 2003, three of the four RMP stations in Suisun Bay exceeded guidelines for total PCBs and all four stations exceeded guidelines for total copper (San Francisco Estuary Institute 2005). However, the highest copper concentrations were at a station in San Pablo Bay that had a very high concentration of total suspended sediments. PCB concentrations were highest in the South Bay and Lower South Bay.

Sediments

In general, the concentrations of contaminants in North Bay sediments are higher than those in Central Bay sediments and lower than those in South Bay sediments (San Francisco Estuary Institute 2001). Lead is an exception to this general pattern. North Bay sediments have a lower mean and range of lead concentrations than Central Bay and South Bay sediment.

The only sediment testing in the immediate vicinity of the Shell Terminal was done to evaluate the concentrations of contaminants in the sediments near the refinery effluent outfall in 1993. The results of this testing are presented later in this section. Representative sampling locations include the RMP Pacheco Creek station in Suisun Bay east of the Shell Terminal, a Carquinez Strait reference site, and the Bulls Head Channel location located offshore from the Shore Terminal.

Tables 4.2-9 and 4.2-10 show 1999 through 2001 sediment contaminant concentrations at the RMP Pacheco Creek station in Suisun Bay east of the Shell Terminal. All samples exceeded the ER-M for nickel although none exceeded the San Francisco Estuary Ambient Concentration. One sample in 1999 exceeded the ER-L for arsenic and one sample exceeded the San Francisco Estuary Ambient Concentration for cadmium (but not the ER-L). Two samples at the Pacheco Creek station exceeded the San Francisco Ambient Concentration for total PAHs (but not the ER-L) and two samples exceeded the ER-L for total DDT but not the San Francisco Ambient Concentration.

In the 2003 RMP sampling, a majority of the lowest sediment concentrations were measured at stations in Suisun Bay (San Francisco Estuary Institute 2005). The exceptions were copper, nickel and zinc. The Pacheco Creek RMP station was sampled in 2003 and had no contaminants above Ambient Sediment Concentration thresholds, two contaminants above the ER-L (copper, mercury) and one above the ER-M (nickel). Sediments at this station were toxic to bivalves (mussels) but not to amphipods.

Table 4.2-9
Sediment Composition and Trace Metal Concentrations of Sediment Samples From Station BF 10 - Pacheco Creek

Parameter	2/99	7/99	7/00	8/01
% Clay (< 4pm)	12	17	13	12
% Silt (4 pm-63 pm)	7	10	9	8
% Sand (63 pm-2 mm)	81	73	78	80
Ag (Silver) (mg/kg)	ND	0.07	0.07	0.04
Al (Aluminum) (mg/kg)	22350	14738	21802	26318
As (Arsenic) (mg/kg)	NA	9.2*	5.45	6.83
Cd (Cadmium) (mg/kg)	**0.35**	NA	0.14	0.17
Cr (Chromium) (mg/kg)	67	55	NA	NA
Cu (Copper) (mg/kg)	21	22	21.9	23.4
Fe (Iron) (mg/kg)	29529	26381	30817	30232
Hg (Mercury) (mg/kg)	0.06	0.09	0.09	0.08
Mn (Manganese) (mg/kg)	533	455	411	401
Ni (Nickel) (mg/kg)	72**	68**	71.6**	60.2**
Pb (Lead) (mg/kg)	7.4	10.9	11.4	9.5
Se (Selenium) (mg/kg)	0.09	0.11	0.1	0.13
Zn (Zinc) (mg/kg)	76.9	78.4	75.5	72.8

NA = Not Analyzed / Not Available.
*** = Exceeds ER-L**
**** = Exceeds ER-M**
Bold = Exceeds San Francisco Estuary Ambient Concentration
Source: SFEI 2001

Table 4.2-10
PAH, PCB, and Pesticide Concentrations in Sediment Samples from Station BF 10 – Pacheco Creek

Parameter	2/99	7/99	7/00	8/01
Sum PAHs (pg/kg)	**356**	**323**	190	176
Sum PCBs (pg/kg)	3.6	2.6	0.3	0.2
Sum DDTs (pg/kg)	1.4	2.4*	1.981*	0.5
Sum Chlordanes (pg/kg)	0.7	ND	0.238	ND
Heptachlor (pg/kg)	0.2	ND	ND	ND
Sum HCHs (pg/kg)	ND	ND	ND	ND
Aldrin (pg/kg)	ND	ND	NA	ND
Dieldrin (pg/kg)	ND	ND	ND	ND
Endrin (pg/kg)	ND	ND	ND	ND

NA = Not Analyzed / Not Available.
*** = Exceeds ER-L**
ND = Not Detected.
Bold = Exceeds San Francisco Estuary Ambient Sediment Concentration
Source: SFEI 2001

Table 4.2-11 shows the concentrations of contaminants in Carquinez Strait and the Bulls Head Channel, offshore from the Pacific Atlantic Terminal, in southwestern Suisun Bay. Note that this location is the most proximate to the Shell Terminal. All samples in Carquinez Strait exceeded the ER-L and San Francisco Estuary Ambient Concentration for chromium. All Carquinez Strait samples also exceeded the San Francisco Estuary Ambient Concentration for selenium. All Carquinez Strait samples exceeded the ER-L for arsenic, while some samples also exceeded the San Francisco Estuary Ambient Concentration. In addition some samples in Carquinez Strait exceeded one or more sediment criteria for PAHs, mercury, cadmium, copper, lead, nickel (exceeded ER-M), and zinc. In Bulls Head Channel, all samples exceeded the ER-L and San Francisco Estuary Ambient Concentration for chromium, and all samples exceeded the ER-M for nickel. The higher range of the samples also exceeded the San Francisco Estuary Ambient Concentration for nickel. The higher end of the range of Bulls Head Channel samples exceeded the ER-L for arsenic and the San Francisco Estuary Ambient Concentration for silver.

Table 4.2-12 shows more recent data on sediments at the Pacific Atlantic Terminal in southwestern Suisun Bay compared to a Carquinez Strait reference site. Note that this data is the most relevant available. Sediments at the Pacific Atlantic Terminal were 71.9 percent sand while Carquinez Strait sediments were only 19.1 percent sand. The only organic contaminants detected at the terminal were low levels of PAHs and Tributyltin (TBT). No pesticides or PCBs were detected. No metal at the terminal exceeded the ER-M level. However, arsenic, chromium, copper, lead, mercury, nickel, and zinc exceeded the ER-L level at the Shore Terminal. Cadmium, copper, lead, mercury, and zinc at the Pacific Atlantic Terminal exceeded the San Francisco Estuary Ambient Concentration. The Carquinez Strait reference area exceeded the ER-L and Ambient Sediment Concentration thresholds for chromium and copper. The Carquinez Strait samples exceeded the ER-M for nickel but not the Ambient Sediment Concentration. The Carquinez Strait samples exceeded the Ambient Sediment Concentration but not the ER-L for cadmium and fluorine.

The only sediment testing in the immediate vicinity of the Shell Terminal was done to evaluate the concentrations of contaminants in the sediments near the refinery effluent outfall in 1993 (Jenkins, Sanders and Associates 1995). Sediments in the vicinity of the Shell Terminal ranged from 64.8 to 77.6 percent fines (Table 4.2-13). Table 4.2-14 shows the concentration of metals in the vicinity of the Shell outfall and at a reference site 2.7 kilometers away. All sediment samples in the vicinity of the Shell facility exceeded the ER-M for nickel but no samples exceeded the Ambient Sediment Concentration. All but one of the sediment samples exceeded the ER-L for copper but only one replicate 60 m from the Shell outfall exceeded the Ambient Sediment Concentration. Two samples exceeded the Ambient Sediment Concentration for cadmium but none exceeded the ER-L. Two replicates exceeded the Ambient Sediment Concentration for selenium. Both replicates at the station 60 m from the outfall exceeded the ER-L for mercury, but only one of the replicates exceeded the Ambient Sediment Concentration. The study did not suggest that discharges from the outfall were increasing the concentration of metals in the sediments.

Table 4.2-11
Sediment Contaminant Concentrations in Project Area

Parameters	Bullshead Channel, Suisun Bay	Carquinez Strait
Grain Size (%)		
Gravel	0 – 1	0 – 4
Sand	80 – 97	4 – 94
Silt	0 – 12	3 – 51
Clay	2 – 8	3 – 52
Total Organic Carbon (%)	0.11 – 0.3	0.4 – 2.2
Organic Contaminants (pg/kg)		
Tributyltin	ND	0.6 – 29
Dibutyltin	ND	1 – 12
Monobutyltin	ND	0.7 – 4
Oil and Grease (mg/kg)	NA	9 – 111
TRPH (mg/kg)	0 – 14	12 – 62
DDT and metabolites	ND	ND
Pesticides	ND	ND
total PCBs	ND	ND
total PAHs	4 – 47	26 – **392**
Metals (mg/kg)		
Arsenic (As)	6.2 – 8.8*	8.4* – **21***
Mercury (Hg)	0.01 – 0.03	0.06 – **0.45***
Selenium (Se)	0.1 – 0.2	**0.8 – 1.0**
Cadmium (Cd)	0.1	0.1 – **0.6**
Chromium (Cr)	**230* – 334***	**164* – 269***
Copper (Cu)	17 – 29	17 – **67***
Lead (Pb)	7 – 12	10 – **34**
Nickel (Ni)	83* – **106****	81* – **120****
Silver (Ag)	0.3 – **0.4**	0.03 – 0.3
Zinc (Zn)	72 – 77	71 – **147**

NA = Not Analyzed / Not Available.
ND = Not Detected.
*** = Exceeds ER-L**
**** = Exceeds ER-M**
bold + Exceeds San Francisco Estuary Ambient Concentrations
Source: USACE, EPA, BCDC, RWQCB, and SWRCB 1998

Table 4.2-12
Summary of 2000 Sediment Characterization in Project Area

Analyte (1)	Shore Martinez Terminal	Carquinez Reference	Detection Achvd (%)	Limit Reqd (2)
Grain size (%)				
Gravel	0.4	11.1		
Sand	71.9	19.1		
Silt	11.9	29.4		
Clay	16.9	40.8		
Solids (%) (Dry Wt.)	67.6	47.0	0.1	0.1
Sulfides (mg/kg)				
Water Soluble	<0.01	<0.01	0.01	0.1
Total Organic Carbon (%)	0.4	1.68	0.1	0.1
Organotins (pg/kg)				
Dibutyltin	ND	ND	2.0	1.0
Monobutyltin	ND	ND	2.0	1.0
Tetrabutyltin	ND	ND	2.0	1.0
Tributyltin	4	8	2.0	1.0
Metals (mg/kg)				
Arsenic (As)	11.2*	13.6*	0.05	0.1
Cadmium (Cd)	**0.52**	**0.4**	0.05	0.1
Chromium (Cr)	84.3*	**262***	0.05	0.1
Copper (Cu)	**92.7***	**77***	0.05	0.1
Lead (Pb)	**59.5**	25	0.05	0.1
Mercury (Hg)	**0.37**	0.26	0.01	0.02
Nickel (Ni)	28.4*	161**	0.05	0.1
Selenium (Se)	0.57	1.02	0.05	0.1
Silver (Ag)	0.3	0.32	0.01	0.1
Zinc (Zn)	**159***	141	0.05	0.1
PAHs (pg/kg)				
Acenaphthene	8	7	5	20
Acenaphthylene	ND	ND	5	20
Anthracene	7	9	5	20
Benzo(a)anthracene	11	26	5	20
Benzo(a)pyrene	11	17	5	20
Benzo(B)Fluoranthene	ND	15	5	20
Benzo(g,h,i)perylene	10	8	5	20
Benzo(k)fluoranthene	12	15	5	20
Chrysene	11	30	5	20
Dibenzo(a,h)anthracene	ND	ND	5	20
Fluoranthene	41	70	5	20
Fluorene	**13**	**10**	5	20
Ideno(1,2,3-CD)pyrene	7	9	5	20
Naphthalene	7	16	5	20
Phenanthrene	**18**	28	5	20

Table 4.2-12 (continued)
Summary of 2000 Sediment Characterization in Project Area

Analyte (1)	Shore Martinez Terminal	Carquinez Reference	Detection Achvd (%)	Limit Reqd (2)
Pyrene	40	84	5	20
Total PAHs	181	328		
(1) All chemical analyses are given as dry weight basis. * Exceeds ER-L (2) Detection limits required by USACOE. ** Exceeds ER-M Bold = Exceeds San Francisco Estuary Ambient Concentration Source: Advanced Biological Testing 2000				

Table 4.2-13
Sediment Grain Size for the Shell Oil Martinez Refinery
(percent dry weight)

Site	Gravel		Sand					Clay	Silt
	Med	Fine	VC	Coarse	Med	Fine	VF		
Distance from outfall									
5 m (NF)									
Mean	0.00	0.15	1.48	1.59	1.91	10.94	5.76	40.57	37.03
StdDev	0.00	0.18	1.69	1.71	0.40	2.89	1.50	4.52	2.78
30 m (MF)									
Mean	0.00	0.13	0.23	0.34	2.39	23.60	8.29	29.50	35.33
StdDev	0.00	0.08	0.09	0.13	0.74	8.64	0.77	5.07	4.97
60 m (FF)									
Mean	2.32	0.99	1.24	1.08	6.05	19.47	5.91	33.73	32.20
StdDev	2.03	0.46	0.22	0.32	1.16	4.76	0.78	6.70	0.46
2.7km – Reference site									
Mean	1.14	0.12	0.20	0.15	0.11	0.53	0.97	49.93	48.07
StdDev	1.97	0.11	0.05	0.04	0.04	0.15	0.36	2.38	0.81

Table 4.2-15 shows the concentrations of PAHs, DDTs and PCBs in the sediments near the Shell outfall and at the reference site. Total PAHs near the outfall exceeded the ER-L and the Ambient Sediment Concentration. Total PAH concentrations close to the outfall were much higher than at the reference site suggesting that the outfall may have been contributing PAHs to the sediments. The concentration of total DDTs in all samples exceeded the ER-L and the Ambient Sediment Concentration. However, the concentration of total DDTs was higher at the reference site than at the outfall, suggesting area-wide contamination and not contamination associated with Shell's operations. Finally total PCBs exceeded the ER-M and Ambient Sediment Concentration at the station 60 m from the outfall and exceeded the Ambient Sediment Concentration at the reference site. PCB concentrations were lowest at the station closest to the outfall.

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Table 4.2-14
Sediment Trace Element Concentrations Adjacent to the Shell Oil Martinez Refinery
(mg/kg, dry weight)

Site	Chromium (Cr)	Vanadium (V)	Cobalt (Co)	Nickel (Ni)	Copper (Cu)	Zinc (Zn)	Arsenic (As)	AA-hydrid Selenium	Molybdenum (Mo)	Cadmium (Cd)	Antimony (Sb)	Lanthanum (La)	Cerium (Ce)	Ytterbium (Yb)	Mercury (Hg)	Lead (Pb)	Silver (Ag)
Distance From Outfall																	
5 m																	
Shell NF-1	46.24	51.53	13.97	61.62**	42.41*	83.72	6.31	<0.26	<0.17	0.24	<0.15	8.85	22.05	0.71	<0.16	21.81	0.14
Shell NF-2	41.62	53.89	13.99	62.91**	45.86*	83.47	5.81	<0.26	<0.17	0.27	<0.15	8.77	22.05	0.75	<0.16	20.84	0.18
Shell NF-3	41.46	52.77	12.73	61.50**	38.68*	81.54	6.85	<0.26	<0.17	0.32	<0.15	10.01	23.32	0.72	<0.16	22.02	0.33
Mean	43.11	52.73	13.56	62.01**	42.32*	82.91	6.32	<0.26	<0.17	0.27	<0.15	9.21	22.48	0.73	<0.16	21.56	0.22
Std	2.72	1.18	0.72	0.78	3.59	1.19	0.52	NC	NC	0.04	NC	0.70	0.73	0.02	NC	0.63	0.10
30 m																	
Shell MF-1	57.03	56.14	12.30	57.92**	35.31*	72.32	7.65	<0.26	<0.17	**0.43**	<0.15	9.50	21.06	0.77	<0.16	25.22	0.14
Shell MF-2	51.44	51.31	11.93	55.50**	35.18*	73.31	6.88	<0.26	<0.17	0.27	<0.15	8.94	20.74	0.65	<0.16	24.56	0.15
Shell MF-3	46.02	55.33	12.20	56.36**	33.87	72.95	6.25	**0.65**	<0.17	0.22	<0.15	9.29	22.14	0.65	<0.16	22.20	0.21
Mean	51.50	54.26	12.14	56.59**	34.79*	72.86	6.93	0.39	<0.17	0.31	<0.15	9.24	21.31	0.69	<0.16	23.99	0.17
Std	5.51	2.59	0.19	1.23	0.79	0.50	0.70	0.22	NC	0.11	NC	0.28	0.74	NC	NC	1.59	0.04
60 m																	
Shell FF-2	40.53	52.88	12.53	56.20**	**71.98***	87.60	5.91	0.60	<0.17	**0.97**	<0.15	9.26	21.66	0.66	0.35*	22.21	0.73
Shell FF-3	47.82	58.48	13.31	60.23**	37.84*	79.06	6.99	**0.70**	<0.17	0.30	<0.15	9.95	23.47	0.72	**0.51***	24.03	0.13
Mean	44.18	55.68	12.92	58.21	54.91*	83.33	6.45	**0.65**	<0.17	0.63	<0.15	9.61	22.56	0.69	0.43*	23.12	0.43
Std	5.15	3.96	0.55	2.85	24.14	6.04	0.76	0.07	NC	0.47	NC	0.49	1.28	0.05	0.11	1.29	0.42
2.7 km – Reference Site																	
Shell REF-1	47.00	53.74	13.59	62.80**	40.42*	85.16	6.19	<0.26	<0.17	0.16	<0.15	9.88	24.39	0.92	<0.16	26.04	0.23
Shell REF-2	48.99	56.68	13.98	67.70**	41.87*	85.49	6.17	<0.26	<0.17	0.17	<0.15	9.86	24.33	0.90	<0.16	25.28	0.21
Shell REF-3	49.89	53.31	13.66	67.94**	41.47*	85.59	5.14	<0.26	<0.17	**0.64**	<0.15	9.14	22.49	0.97	<0.16	23.93	0.32
Mean	48.63	54.58	13.74	66.15**	41.25*	85.41	5.83	<0.26	<0.17	0.32	<0.15	9.63	23.74	0.93	<0.16	25.08	0.25
Std	1.48	1.83	0.20	2.90	0.75	0.22	0.60	NC	NC	0.27	NC	0.42	1.08	0.03	NC	1.07	0.06
PQL (mg/kg dry weight)	5.49	0.18	0.05	1.54	0.91	0.65	1.02	0.51	0.33	0.18	0.29	0.15	0.09	0.22	0.31	0.20	0.12

Values which are below detection limits are set at 1/2 PQL for statistical analysis.
Measurements performed by the Molecular Ecology Institute.
NC = not calculated
Bold = Exceeds Ambient Sediment Concentration
*** = Exceeds ER-L**
**** = Exceeds ER-M**

Table 4.2-14 – Sediment Trace Element Concentrations Adjacent to the Shell Oil Martinez Refinery (mg/kg, dry weight) (FOLD OUT)

Table 4.2-15
Concentrations of Total PAHs, Total DDTs and Total PCBs Based on the Summation of Sediment Hydrocarbon Concentrations Associated With the Shell Oil Martinez Refinery (µg/kg, dry weight)

Site	Total PAHs	Total DDTs	Total PCBs
Distance From Outfall			
5 m			
Mean	**4429.99***	**18.14***	4.68
StdDev	2964.39	10.90	0.66
30 m			
Mean	1601.55	**12.71***	12.38
StdDev	213.97	7.32	6.98
60 m			
Mean	2043.43	**17.59***	**464.17****
StdDev	803.23	9.88	778.47
2.7 km – Reference Site			
Mean	995.58	**20.58***	16.86
StdDev	164.82	4.17	4.49

Bold = Exceeds Ambient Sediment Concentration
*** = Exceeds ER-L**
**** = Exceeds ER-M**

4.2.2 Regulatory Setting

The regulatory framework includes laws, regulations, plans, polices, and programs at the Federal, State, local, and regional levels. Specific laws and regulations are referenced later in the text, and provide the underlying basis for plans, policies, and programs.

Federal Policies

The Federal CWA (35 U.S.C. 1251 et. seq.) delegates certain responsibilities in water quality control and water quality planning to the states. In California, the California Environmental Protection Agency (Cal EPA) and the State Water Resources Control Board (SWRCB) agreed to such delegation; and regional boards implement portions of the CWA, such as the issuance of NPDES permits. The aim of the CWA of 1977 (33 U.S.C. 1251 et seq.) is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Specific sections control the discharge of wastes into marine and aquatic environments. CWA Section 402 states that discharge of pollutants to waters of the United States is unlawful unless the discharge is in compliance with an NPDES permit. CWA Section 404 establishes a permit program to regulate the filling of jurisdictional waters including the discharge of dredged material into waters of the United States. The USACE has jurisdictional authority pursuant to CWA Section 404. The EPA assists the USACE in evaluating environmental impacts of dredging and filling, including water quality and historic and biological values. CWA

Section 401 requires that activities permitted under Section 404 must not cause concentrations of chemicals in the water column to exceed State standards. CWA Section 303(d) requires that states develop a list of water bodies that need additional work beyond existing controls to achieve or maintain water quality standards. The additional work includes the establishment of TMDLs of pollutants that have impaired the water body.

The National Estuary Program was established in 1987 by amendments to the CWA to identify, restore, and protect nationally significant estuaries of the United States. The San Francisco Estuary Project is one of over 20 Estuary Projects established by the National Estuary Program. The San Francisco Estuary Project is a cooperative Federal, State, and local program to promote effective management of the San Francisco Bay-Delta Estuary.

The Coastal Zone Management Act of 1972 (16 U.S.C. 1455 et. seq.) regulates development and use of the nation's coastal zone by encouraging states to develop and implement coastal zone management programs. Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) (16 U.S.C. 1455b) required the coastal states with federally approved coastal zone management plans to develop and submit coastal nonpoint source pollution control programs for approval by the National Oceanic and Atmospheric Administration (NOAA) and the Environmental Protection Agency (EPA). Long-range planning and management of California's coastal zone were conferred to the State with implementation of the California Coastal Act of 1976.

State Plans and Policies

The quality of California's coastal environment is protected under the California Coastal Act, which established the CCC. Several provisions of the California Coastal Act serve to protect coastal water quality from point and nonpoint source pollution. The McAteer-Petris Act governs planning and management of the San Francisco Bay portion of the California Coastal Management Program. The McAteer-Petris Act established the San Francisco BCDC as the agency responsible for protection of San Francisco Bay that includes critical and sensitive Bay areas.

The California Porter-Cologne Water Quality Control Act of 1969 established the SWRCB and nine RWQCBs as the principal State agencies with primary responsibility for the coordination and control of water quality. The SWRCB is generally responsible for setting statewide water quality policy. Each RWQCB makes water quality and regulatory decisions for its region. In 1991, the SWRCB and RWQCBs were brought together with five other State environmental protection agencies under the newly crafted Cal EPA. Measures to protect and restore the quality of California's coastal water also are addressed in the State's Plan for California's Nonpoint Source Pollution Control Program, which the State prepared pursuant to both the CWA and the CZARA.

The Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan) (RWQCB 1995) is the primary policy document that guides the RWQCB, San Francisco Bay Region. Established under the requirements of the 1969 Porter-Cologne Water Quality Control Act, the Basin Plan was originally adopted in April 1975, and the most recent revisions were adopted in 1995 and approved by the EPA in 2000. In January of 2004 amendments to the Basin Plan were adopted that included application of California Toxic Rule water quality criteria and definitions in lieu of Basin Plan water quality objectives, update of Basin Plan provisions relating to implementation of water quality standards, and several non-regulatory updates. The Basin Plan applies to point and nonpoint sources of waste discharge to the San Francisco Bay, but not to vessel wastes or the control of dredge material disposal or discharge. The Basin Plan assigns beneficial uses to all waters in the basin. These beneficial uses include municipal, industrial, and agricultural water supply; freshwater replenishment and groundwater recharge; water contact and noncontact recreation; navigation; commercial and sport fishing; shellfish harvesting; marine, estuary, wildlife, and warm and cold freshwater habitat; preservation and enhancement of Areas of Biological Significance; and rare and endangered species, wildlife, fish migration, and fish spawning. The Basin Plan also sets water quality objectives, subject to approval by the EPA, intended to protect designated beneficial uses. The water quality objectives in the Basin Plan are written to apply to specific parameters (numeric objectives) and general characteristics of the water body (narrative objectives). The water quality objectives are achieved primarily through effluent limitations embodied in the NPDES program.

The San Francisco Bay Region RWQCB has NPDES permit authority on any facility or activity that discharges waste into the San Francisco Bay. Effluent limits are contained within the NPDES permit; the discharge of process wastewater containing constituents in excess of the limits stated within the NPDES permit is prohibited.

The MISA of 2003 (Public Resources Code sections 71200 through 71271), which became effective January 1, 2004, revised and expanded the Ballast Water Management for Control of Nonindigenous Species Act of 1999. (See Appendix D for key components of the Act.) The MISA specifies mandatory mid-ocean exchange or retention of all ballast water for vessels carrying ballast water into California waters after operating outside the US EEZ. For vessels coming from other west coast ports, the act requires minimization of ballast water discharges in state. However, beginning March 22, 2006, all vessels operating within the Pacific Coast Region will be required to manage ballast water. Management options include retention of all ballast water, exchange of ballast water in near-coastal waters, before entering the waters of the state, if that ballast water has been taken on in a port or place or within the Pacific Coast region. All vessels are required to complete and submit a ballast water reporting form, maintain a vessel-specific ballast water management plan and ballast tank log book, remit the necessary fee to the Board of Equalization, and submit to compliance verification inspections.

The California Clean Coast Act (SB 771) went into effect January 1, 2006, and has several requirements to reduce pollution of California waters from large vessels. The California Clean Coast Act prohibits the operation of shipboard incinerators within 3 miles of the California coast, prohibits the discharge of hazardous wastes, other wastes or oily bilgewater into California waters or a marine sanctuary, prohibits the discharge of graywater and sewage into California waters from vessels with sufficient holding tank capacity or vessels capable of discharging graywater and/or sewage to available shoreside reception facilities, requires reports of prohibited discharges to the California State Water Resources Board, and submission of an information report to the CSLC.

The CSLC issues dredging permits for projects that propose to dredge in State-owned submerged lands, tidelands, and marshes. In addition, any project sponsor seeking to use State-owned lands for right-of-way uses must obtain a land use lease from the CSLC. For each of these discretionary decisions, the CSLC bases its decision on information presented in environmental documentation prepared pursuant to the requirements of the CEQA and the National Environmental Policy Act (NEPA).

Local and Regional Plans and Water Quality Policies and Programs

The BCDC's San Francisco Bay Plan, adopted in 1968, provides policies to guide future uses of the San Francisco Bay and shoreline. BCDC regulates all San Francisco Bay dredging and filling to protect marshes, wetlands, and other resources of the San Francisco Bay. Its jurisdiction includes all areas of the San Francisco Bay below the line of highest tidal action as well as 100 feet inland from the line of highest tidal action. The San Francisco Bay Plan designates the area in the vicinity of the Shell Terminal along the southern shore of Carquinez Strait/Suisun Bay between the Martinez-Benicia Bridge and Pacheco Creek for tidal marsh and Water-Related Industry. The Plan specifies that in this area "pipelines and piers may be built over marshes." Policies within the Plan indicate that "pipeline terminal and distribution facilities near the San Francisco Bay should generally be located in industrial areas" and that "marine terminals should also be shared as much as possible among industries and port uses."

The LTMS for Placement of Dredged Materials in the San Francisco Bay region is a cooperative effort of the EPA, the USACE, SWRCB, the RWQCB, and the BCDC to develop a new approach to dredging and dredged material disposal in the San Francisco Bay area. The major goals of the LTMS are to:

1. Maintain, in an economically and environmentally sound manner, those channels necessary for navigation in the San Francisco Bay and Estuary while eliminating unnecessary dredging activities;

2. Conduct dredged material disposal in the most environmentally sound manner;

3. Maximize the re-use of dredged material as a resource; and

4. Establish a cooperative permitting framework for dredging and disposal of dredged materials.

The LTMS agencies completed a Final Policy EIS/Programmatic EIR (October 1998), proposing the new long-term plan for achieving these goals. The new approach calls for reducing disposal within San Francisco Bay over time, and increasing recycling of dredged material for “beneficial uses,” including habitat restoration, levee maintenance, and construction fill. The LTMS agencies have also established an interagency Dredged Material Management Office (DMMO), which serves as a “one stop shop” for San Francisco Bay Area dredging permit applications. In July of 2001 the LTMS agencies issued the Long-term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region Management Plan 2001 (USACE, USEPA, BCDC, and SWBRWQCB 2001). This Management Plan presents specific mechanisms to implement the long-term dredging, disposal and beneficial reuse strategy.

The CALFED Bay-Delta Program was formed to resolve conflicts over freshwater uses in the Bay Delta. The mission of the CALFED Bay-Delta Program is to develop a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta System. State-Federal cooperation was formalized in June 1994 with the signing of a Framework Agreement by the State and Federal agencies with management and regulatory responsibility in the Bay-Delta Estuary. The CALFED agencies are:

Federal: Bureau of Reclamation, USFWS, EPA, Department of Commerce, NOAA Fisheries, the USACE, Department of Agriculture, and Natural Resources Conservation Service.

State: Resources Agency, Department of Water Resources, CDFG, Cal EPA, SWRCB, and CSLC.

These agencies provide policy direction and oversight for the process.

The Framework Agreement pledged that the State and Federal agencies would work together in three aspects of Bay-Delta management: (1) water quality standards formulation, (2) coordination of State Water Project and Central Valley Project operations with regulatory requirements, and (3) long-term solutions to problems in the Bay-Delta Estuary.

4.2.3 Impact Significance Criteria

The significance of impacts was considered in the context of whether the Shell Terminal’s operations would likely result in pollutant levels above ambient water quality and sediment levels and whether increased levels would exceed water quality objectives of the RWQCB or the SWRCB. The significance of impacts was considered in the context of contaminant levels for San Francisco Bay in general and the Project area in particular. For example, operations that would result in changes from background that are not discernible in the local area or region were considered less than significant impacts.

Impacts to marine water quality were considered significant if any of the following apply:

- The water quality objectives contained in the Water Quality Control Plan for San Francisco Basin (RWQCB 1995) (Table 4.2-1) or the California Ocean Plan (Table 4.2-2) are exceeded;
- The WQC in the California Toxics Rule (EPA 2000) (Table 4.2-3) are exceeded; and/or
- Project operations or discharges that change background levels of chemical and physical constituents or elevate turbidity would produce long-term changes in the receiving environment of the site, area, or region that would impair the beneficial uses of the receiving water.

Impacts are considered adverse but less than significant (Class III) if the Project could result in elevation of contaminants, but the levels remain below WQC, or if elevation of contaminant concentrations above criteria occurs only within a couple of hundred feet or less of the point of discharge for a few hours or less.

4.2.4 Impacts Analysis and Mitigation Measures

4.2.4.1 Shell Terminal Routine Operations and Potential for Accident Conditions

Impact WQ-1: Sediment Disturbance to Water Quality from Vessel Maneuvers

Disturbed sediments could cause a brief, localized depression in dissolved oxygen concentrations and turbidity, but would disperse rapidly with the strong tidal currents in the area, and be rapidly mitigated by tidal mixing with San Francisco Bay waters of high dissolved oxygen concentration. Such events would occur for an hour or less during a 24-hour period and be limited to the immediate vicinity of the terminal, thus increased turbidity due to vessel traffic would be adverse, but less than significant (Class III).

Between 1999 and 2005, an average of 7 tankers and 10 barges visited the Shell Terminal per month. These vessels and barges are assisted by tugs in berthing and unberthing operations. The number of tugs used in docking or maneuvering of vessels depends on the size of the vessel and environmental conditions. The number can vary from one to as many as four. Berthing operations can affect water quality by propeller wash from tankers and tugs eroding bottom sediments in the immediate vicinity of the Shell Terminal. Strong tidal currents occur in the vicinity of the Shell Terminal. The ship's propulsion system is used to compensate for the tidal current and head winds. The large propellers on tankers of large drafts are close to the bottom of the San

Francisco Bay and the turbulence from these propellers can erode bottom sediments. The transit of deep-draft vessels through San Francisco Bay to the Shell Terminal can also re-suspend sediments and benthic biota in the water column where bottom depths are near that of the vessel draft. The propeller wash from tugs is nearer the surface and has less of an erosion effect on bottom sediments.

The Shell Terminal has four berths but only the outer berths, Berth #1 and Berth #2, are currently being used. The north side of the Shell Terminal normally maintains a minimum draft of minus 38 feet MLLW and has not been historically dredged because the strong currents in Carquinez Strait keep the berths from accumulating sediment. The maximum draft of vessels visiting the Shell Terminal is 32.5 feet. Berths #3 and #4 on the inner (south) side of the pier are not currently in use due to accumulated silt. They may be dredged to -20 feet MLLW in the future and re-instated for use.

The re-suspension of bottom material from propeller wash and bow thrusters can affect turbidity in the immediate vicinity of vessel operations. The San Francisco Bay Basin Plan water quality objectives specify that waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses (RWQCB 1995). The Basin Plan objective for dissolved oxygen states that for tidal waters downstream of Carquinez Bridge, dissolved oxygen shall not be depressed below 5 mg/L.

A turbid plume of water is often evident in turbulent propeller wash of large deep-draft vessels in relatively shallow harbors and bays. This turbid plume would be short-lived. Observations of turbidity caused by boat wakes indicate that the plume generally persists less than 10 minutes. Depending on the depth of propeller wash scour, sediments might be anaerobic and could cause a brief, localized depression in dissolved oxygen concentrations. This re-suspended sediment material would disperse rapidly with the strong tidal currents in the area, and any depression in dissolved oxygen would be rapidly mitigated by tidal mixing with San Francisco Bay waters of high dissolved oxygen concentration. No increase in turbidity was observed during vessel berthing operations at the Shore Terminal, located approximately two miles to the east of the Shell Terminal during a visit by the EIR project team in August 2002 (Chambers Group 2005).

Bottom scour conditions may occur when deep-draft vessels are using their propulsion systems while berthing at the Shell Terminal. An average of 7 tankers and 10 barges per month, along with their associated tugboats, call at the terminal, and it takes about 1 hour to secure the vessel or barge to the dock. Therefore, turbidity caused by vessels at the Shell Terminal would occur less than 5 percent of the time on average [(1 hour for vessel arriving + 1 hour for vessel departing) x (17 vessels per month)/ (732 hours per month) = 4.6 percent of the time]. With a maximum of 330 annual vessel calls over the lease period, this could increase to 7.5 percent. Because these events would occur for an hour or less, impacts would be limited to the immediate vicinity of the Shell Terminal, increased turbidity due to vessel traffic would be adverse but less than significant (Class III). There is no evidence that turbidity related to vessel traffic is degrading beneficial uses of Carquinez Strait and Suisun Bay.

The Martinez Marina, approximately 0.5 mile to the southwest of the Shell Terminal, has experienced severe siltation. Concerns were raised at the scoping meeting for this EIR that re-suspension of sediments by ships using the Shell Terminal may contribute to this problem. No study has been done to quantify the amount of silt re-suspended by vessels using the Shell Terminal that may be transported into the marina. The vessels themselves do not generate the silt, which comes from the San Joaquin and Sacramento Rivers. The estimated average annual sediment load between 1995 and 2001 was approximately 3.6 million cubic yards per year (San Francisco Estuary Institute 2003). As discussed above, vessels going to and from the Shell Terminal may re-suspend bottom sediments. However, the number of vessels visiting the Shell Terminal is a small percentage of the total vessel traffic through Carquinez Strait. Less than 20 vessels per month visit the Shell Terminal. In addition, the fact that Berths #1 and #2 are subjected to scour rather than sediment deposition suggests that the strong currents in Carquinez Strait keep sediments in the vicinity of these berths in suspension. Therefore, because sediment in the Project area is generated by the major upstream rivers and kept in suspension through Carquinez Strait by the strong currents in the area and because vessels using the Shell Terminal represent a small percentage of vessel traffic in Carquinez Strait, the Shell Terminal's contribution to sedimentation problems in Martinez Marina is expected to be adverse, but less than significant (Class III).

<u>WQ-1: No mitigation is required</u>.

Impact WQ-2: Segregated Ballast Water

Discharge of ballast water that contains harmful microorganisms could impair several of the Project area's beneficial uses, including commercial and sport fishing, estuarine habitat, fish migration, preservation of rare and endangered species, water contact recreation, non-contact water recreation, fish spawning, and wildlife habitat. Therefore discharge of segregated ballast water is determined to have a potentially significant impact to water quality (Class I).

Ballast water is used to stabilize tankers and barges. Ballast water is taken to compensate for the lightering of vessels bringing crude oil or feed products to the Refinery. Segregated ballast water is kept in tanks that are segregated from oily cargo. Sometimes, however, ballast may be taken into cargo holds where it will come in contact with oil. Nonsegregated ballast water is considered a hazardous waste in California and cannot be discharged into the Bay or coastal waters.

Vessels may discharge ballast water from segregated ballast tanks into San Francisco Bay as they take on product from the Shell Terminal or during transfer of product from a larger vessel to a smaller vessel or barge at Anchorage No. 9. This ballast water contains the pollutants present in the water at the port where it was taken on. If this water contains higher levels of pollutants than are present in San Francisco Bay, discharge of this water could have an adverse water quality impact. Because the ballast tank is segregated, no pollutants are transmitted to the ballast water from the cargo and little, if any, pollutants occur from leaching of material from segregated ballast tanks. In addition, ballast water contains an assemblage of organisms living in the water where the ballast was taken on.

Ships that visit the Shell Terminal follow an established pattern from as far south as San Pedro, California, to as far north as the Cook Inlet in the Gulf of Alaska. The levels of certain pollutants in some of those ports may exceed ambient levels in Carquinez Strait. In cases where the pollutant in ballast water exceeds the concentration in San Francisco estuary, the volume of water discharged (2.5 million gallons) is small compared to the volume of water in San Francisco Bay so that concentrations in discharged ballast water would reach background levels rapidly. Therefore, the discharge of segregated ballast water at the Shell Terminal or Anchorage No. 9 is not expected to result in long-term elevations of contaminant levels that exceed criteria in the California Toxics Rule.

On the other hand, non-indigenous organisms in ballast water may have significant adverse impacts to biological resources and water quality. Impacts to biological resources are discussed in Section 4.3.4, Impacts Analysis and Mitigation Measures. Release of segregated ballast water could have a significant adverse impact to water quality if viruses, toxic algae or other harmful microorganisms were released. Suisun Bay and Carquinez Strait are on the 303(d) list of impaired water bodies for exotic species. Harmful algal blooms have been associated with such adverse effects as mass mortalities of pelicans and sea lions (attributed to the toxin domoic acid produced by the diatom *Pseudo-nitzchia australis*) off coastal California (Committee on Environment and Natural Resources 2000). Ballast water discharges have been implicated as one mechanism for the spread of harmful algae. In addition, ballast water may contain pathogens causing public health concerns (Falkner 2003).

California Title 2, Division 3, Chapter 1, Article 4.6 prohibits vessels entering California water after operating outside the United States EEZ from discharging ballast water into State waters unless the vessel has carried out a mid-ocean ballast water exchange procedure, or is using an environmentally sound alternative shipboard treatment technology approved by the CSLC. Beginning March 22, 2006, vessels operating within the Pacific Coast Region will be required to manage ballast water taken on within the Pacific Coast Region, by exchanging ballast water in near-coastal water before entering state waters, retaining all ballast water on board, using an approved, environmentally-sound treatment method, or discharging to an approved reception facility. Qualifying vessels must report the time and place ballast water was taken on and released during the voyage. Vessels docking at the Shell Terminal comply with these requirements. (G. Johnson, Shell, pers. comm. 2005). Every ship entering State waters is required to submit a Ballast Water Questionnaire to the CSLC, declaring the coordinates of the location where the ballast exchange took place. Appendix D provides a copy of the form, and additional information on ballast water exchange.

Mid-ocean exchange of ballast water is considered an interim measure to reduce the introduction of exotic species until effective treatment technologies are developed

(Falkner 2003). Mid-ocean exchange reduces the introduction of exotic organisms but is not completely effective. One study of the ballast water of ships that had conducted mid-ocean exchange showed that ships that exchanged ballast water had 5 percent of the number of organisms and half the number of species compared to ships that did not exchange (Cohen 1998). Another study showed that 14 of 32 ships that conducted mid-ocean ballast exchange retained significant amounts of sediment and dinoflagellate cysts. Therefore, because mid-ocean exchange of ballast water is not completely effective, discharge of segregated ballast water is determined to have a potentially significant impact to water quality (Class I).

<u>Mitigation Measures for WQ-2</u>:

WQ-2. Following the adoption of the Mitigation Monitoring Program for the proposed Project, Shell will advise both agents and representatives of shipping companies having control over vessels that have informed Shell of plans to call at the Shell Terminal about the California Marine Invasive Species Act. Shell will ensure that a Questionnaire containing the following questions is provided to the Vessel Operator, and inform the Vessel Operator that the Questionnaire should be completed on behalf of the vessel, by its Captain or authorized representative, and provided to the CSLC's Marine Facilities Division's Northern California Field and Sacramento Offices, either electronically or by facsimile, prior to the vessel's entry into San Francisco Bay or in the alternative, at least 24 hours prior to the vessel's arrival at the Shell Terminal.

The Questionnaire shall solicit the following information:

1. Does the vessel intend to discharge ballast water in San Francisco Bay, the Carquinez Strait or any other location(s) in a Bay waterway on its transit to the Shell Terminal?

2. Does the vessel intend to discharge ballast water at the Shell Terminal?

3. Which of the following means specified in the California MISA or Title 2, Division 3, Chapter 1, Article 4.6. has the vessel operator used or intend to use on the current voyage to manage the vessel's ballast water: a mid-ocean exchange (as defined in Section 71200(g)); a near-coastal exchange (as defined in Section 71201(b)); retain all ballast on board; or discharge the ballast water at the same location (as defined in Section 71204.2(c)(2)) where ballast originated, provided ballast water was not mixed with ballast water taken on in an area other than mid-ocean waters?

Rationale for Mitigation: Effective systems for the treatment of ballast water to remove all associated organisms have not yet been developed. The measure provides an interim tracking mechanism until a feasible system to kill organisms in ballast water is developed. Until an effective treatment system is developed, the discharge of ballast water to San Francisco Bay will remain a significant adverse impact. Mid-ocean exchange reduces the introduction of exotic species but is not completely effective.

Residual Impacts: Until a feasible system to kill organisms in ballast water is developed, the discharge of ballast water to San Francisco Bay will remain a significant adverse impact (Class I).

Impact WQ-3: Cooling Water

Cooling water discharges on water quality would be adverse, but less than significant (Class III) as the increase in water temperature of the San Francisco Bay would be negligible and would not exceed limitations set forth in the California Thermal Plan.

Besides the discharge of segregated ballast water discussed above, the only other discharge from vessels visiting the Shell Terminal is cooling water flow from the ships' operating systems. Cooling water flow from ship systems includes flow from the main engines and auxiliary equipment operating during the time the ships are berthed at the Shell Terminal. The volume of these cooling water flows is relatively small compared to the tidal flow past the terminal. Therefore, the increase in water temperature of the San Francisco Bay would be negligible and would not exceed limitations set forth in the California Thermal Plan. The impact of cooling water discharges on water quality would be adverse, but less than significant (Class III).

WQ-3: No mitigation is required.

WQ-4: Non-segregated Ballast Water

Non-segregated ballast water that is sent to the treatment facility may include non-indigenous organisms. Treatment at the facility does not include any specific procedures to prevent organisms that may be in ballast water from being discharged to San Francisco Bay waters. Discharge of harmful microorganisms would be a significant adverse impact (Class II).

Non-segregated ballast water that is sent to the treatment facility may include non-indigenous organisms. Treatment at the facility does not include any specific procedures to prevent organisms that may be in ballast water from being discharged to San Francisco Bay waters. Furthermore, the NPDES permit for the discharge does not include limitations on the discharge of organisms or requirements for monitoring of organisms. Filtration of process water at the Shell facility would prevent the introduction of larger organisms. However, the potential exists for harmful microorganisms such as viruses, bacteria, and toxic algae to be discharged. Shell indicates that it does not receive non-segregated ballast water at its treatment facilities (Johnson, Shell, pers. comm. 2005). However, Shell's Wharf Operations Manual refers to the treatment of oily ballast water at the Shell Effluent Treatment Plant (Shell 2004). Discharge of harmful microorganisms that may be in this ballast water would be a significant adverse impact (Class II).

Mitigation Measures for WQ-4:

WQ-4. Shell shall not discharge any non-segregated ballast water received at the Shell Terminal to San Francisco Bay. If Shell needs to unload non-segregated ballast water, it shall be unloaded into a tanker truck or other suitable waste handling vehicle and disposed of at an appropriate facility.

Rationale for Mitigation: Handling of non-segregated ballast water at the Shell Refinery apparently is an extremely rare event. Shell indicated that it does not receive non-segregated ballast water at its facilities. Therefore, transport of non-segregated ballast water to an appropriate disposal facility during the rare occasions when it is necessary to receive such water at the Shell Terminal should be feasible. Disposal of non-segregated ballast water at an approved facility will eliminate the potential introduction of harmful microorganisms that may be in this water

Impact WQ-5: Other Liquid Wastes

Spills of sanitary wastewater, cargo tank washwater or bilge water could degrade water quality and many spills would constitute chronic long-term degradation of water quality, resulting in a significant adverse impact (Class II).

The California Clean Coast Act (SB 771) prohibits the discharge of hazardous wastes, other wastes or oily bilgewater into California waters and also prohibits the discharge of graywater and sewage from vessels with sufficient holding tank capacity or from vessels capable of transferring wastewater to shoreside reception facilities. The California Clean Coast Act requires that all vessels visiting California in 2006 submit a report describing their capability to store graywater and sewage, and providing information on their marine sanitation devices to the CSLC.

Shell does not receive or treat bilge water or other liquid wastes from vessels (Shell 2005). Disposal of these wastes is the responsibility of the ship and is handled by a contract disposal service. Therefore, unless there was a spill during transfer, none of these other wastes, which might include sanitary wastewater, cargo tank washwater and bilgewater would have any impact on water quality in the Project area. A spill, however, would degrade water quality and many spills would constitute chronic long-term degradation of water quality, resulting in a significant adverse impact (Class II).

Vessels are not allowed to offload trash. Therefore, trash would not be discharged to San Francisco Bay waters and there would be no impacts.

Mitigation Measures for WQ-5:

WQ-5. Shell shall prepare a Spill Prevention Plan for grey water, sewage, and other waster water streams and for ships visiting the Shell Terminal that includes Best Management practices (BMPs) specifically to prevent leaks and spills during transfer of liquids between vessels and trucks on the Shell Terminal. The Spill Prevention Plan shall be prepared within 6 months of lease implementation and reviewed by the CSLC and be available to the RWQCB.

Rationale for Mitigation: Aggressive implementation of BMPs to reduce the input of chemicals to the San Francisco Bay from operations on the Shell Terminal would reduce or eliminate the Shell Terminal's input of these chemicals to the environment and thereby reduce water quality degradation at the Shell Terminal.

Impact WQ-6: Cathodic Protection

The slow leaching of zinc anodes may increase metal concentrations, but due to the slow rate of exchange of the anodes to seawater, the impact of cathodic protection on water quality is adverse, but less than significant (Class III).

Tankers and barges calling at the Shell Terminal are made of steel and need cathodic protection. Many of these vessels have a coaltar-epoxy coating on their hull that insulates them from the saltwater. Tankers often use an impressed current system for cathodic protection. Barges typically use sacrificial zinc anodes for cathodic protection. The slow leaching of zinc anodes may increase metal concentrations in the waters at the Shell Terminal, but due to the slow rate of exchange of the anodes to seawater, it is thought to be negligible in comparison to ambient zinc in the marine environment. The impact of cathodic protection on water quality is adverse, but less than significant (Class III).

WQ-6: No mitigation is required.

Impact WQ-7: Anti-Fouling Paints

Use by marine vessels of anti-fouling paints containing copper, sodium, zinc, or TBT are considered toxic and present a significant adverse impact to water quality that cannot be mitigated to less than significant (Class I).

Marine anti-fouling paints are used to reduce nuisance algal and marine growth on ships. These marine growths can significantly affect the drag of the vessel through the water and thus its fuel economy. Anti-fouling paints are biocides that contain copper, sodium, zinc, and TBT as the active ingredients. All of these are meant to be toxic to marine life that would settle or attach to the hull of ships. At a November 1997 session of the IMO Assembly in London, a resolution was approved that calls for the elimination of organotin biocides after 2003. The resolution language bans the application of tin biocides as anti-fouling agents on ships by January 1, 2003, and prohibits the presence of tin biocides after January 1, 2008. The Marine Environment Protection Committee of the IMO is developing a legal instrument to enforce the ban of TBT on vessels (Lewis 2001). Much concern has been raised about TBT effects on non-target marine species.

New types of bottom paints that do not contain metal based biocides are being developed and tested. Some of these coatings, such as self-polishing coatings, are now in use. A new class of coating, called foul-releasing paint contains silicon instead of metals in its base. On a vessel hull, a silicon coating creates a slippery surface which, under certain operating conditions, e.g., vessel speeds over 16 knots/hour, causes fouling organisms to slide off. This silicon based coating and other technologies are anti-fouling paint future options and may become requirements.

However, until such coatings are in wide spread use, the use of high toxicity organotins will continue. The use of these substances on vessels associated with the Shell Terminal is considered to be a significant adverse impact to water quality that cannot be mitigated to less than significant (Class I).

<u>Mitigation Measures for WQ-7</u>:

WQ-7. Following the adoption of the Mitigation Monitoring Program for the proposed Project, Shell will advise both agents and representatives of shipping companies having control over or representing vessels that have informed Shell of plans to call at the Shell Terminal about the requirements of the 2008 IMO prohibition of TBT applications to vessel hulls. Following the effective date of the IMO prohibition, Shell will ensure that the Master or authorized representative of vessels intending to call at the Shell Terminal certifies that their vessel is in compliance and provides a copy of such certification to the CSLC's Marine Facilities Division's Northern California Field and Sacramento Offices, either electronically or by facsimile, prior to the vessel's entry into San Francisco Bay or in the alternative, at least 24 hours prior to the vessel's arrival at the Shell Terminal.

<u>Rationale for Mitigation</u>: Until all TBT is phased out by 2008, vessels with old applications of TBT on their hulls will visit the Shell Terminal. Although it is reasonable for Shell to require vessels to document no new TBT applications (per IMO mandate), Shell cannot feasibly require vessels to remove TBT from their hulls until the IMO mandate prohibiting the presence of TBT on ship hulls comes into effect in 2008. Therefore, until all TBT is gone from vessels using the Shell Terminal, impacts of organotins will remain significant. Prior to the effective date of the IMO mandate, the

mitigation measure has Shell advise agents of shipping companies about the future requirements; after the effective date of the IMO mandate, Shell will certify that visiting vessels are in compliance and submit copies to CSLC. This will help to reduce impact to water quality by eliminating organotins, and also eliminate toxicity to marine organisms.

Residual Impact: Until all TBT is gone from vessels using the Shell Terminal, impacts of organotins will remain significant (Class I).

Impact WQ-8: Tanker Maintenance

Routine vessel maintenance would have the potential to degrade water quality due to chronic spills during transfers of lubricating oils, resulting in adverse significant (Class II) impacts.

Minor repair and routine maintenance of vessels may occur at the Shell Terminal. Most of these repairs have little effect on water quality. Vessels may take on lubricating oils at the Shell Terminal, which have a potential to spill into the water. All transfer areas (i.e., work areas around risers, loading arms, hydraulic systems, etc.) are protected by berms and drain to sumps from which wastes are pumped onshore. No hull cleaning occurs at the Shell Terminal. Routine vessel maintenance would have the potential to degrade water quality due to chronic spills during transfers of lubricating oils. The impact of chronic spills is adverse and significant (Class II).

Mitigation Measures for WQ-8:

WQ-8. MM WQ-5 applies which addresses preparation of a Spill Prevention Plan that includes BMPs for the Shell Terminal.

Rationale for Mitigation: Aggressive implementation of BMPs to reduce the input of chemicals to the San Francisco Bay from operations on the Shell Terminal would reduce the Shell Terminal's input of these chemicals to the environment and reduce water quality degradation at the Shell Terminal to less than significant.

Impact WQ-9: Stormwater Runoff from the Wharf

Stormwater runoff from the Shell Terminal may contribute pollutants to the San Francisco Bay in concentrations that may adversely affect some benthic species within the local area, resulting in a significant adverse impact (Class II) to water quality.

Stormwater runoff is the largest contributor of pollutants to San Francisco Bay (Davis et al. 2000). Hydrocarbons and other contaminants that accumulate on surfaces of the Shell Terminal will run off to the ocean during storms. As described in Section 2.3.2, Physical Description of the Shell Marine Terminal, all drips and discharges on the Shell Terminal drain into collection systems that engage automatically by level control switches to avoid overflows. The Shell Terminal has collection pans under every manifold that act as a back up for the collection system to recover drips and drains from maintenance activities. The pans drain to one sump at each berth. The Shell Terminal also has a thin fuel blender that has a similar drip pan and alarm system. The collection system sump pumps transfer accumulated liquids through a two-inch line to an upland oil-water separator at Shell's ETP. The ETP's oil-water separator pumps oil to a recovered oil tank for transfer back to the Refinery for processing. The ETP is part of the Refinery and treats and discharges wastewater under NPDES Permit CA00005789, thus the ETP is more than sufficient to handle the oily water from the wharf. Shell does not receive or treat bilge water or other liquid wastes from vessels (Shell 2005). Disposal of these wastes are the responsibility of the ship and are handled by a contract disposal service. Hence, pollutants that accumulate on the Shell Terminal deck should not enter the San Francisco Bay and degrade water quality. However, there is the potential for contaminants to accumulate on the surface of other parts of the pier from routine vehicle use, maintenance activities, and other operations.

Concentrations of some contaminants in sediments in the vicinity of the Shell Terminal are at levels that exceed the ER-L or ER-M indicating that some adverse biological effects may occur to species sensitive to these contaminants (Tables 4.2-14 and 4.2-15). Some of these contaminants exceed the concentrations at a nearby reference site and San Francisco Estuary Ambient Sediment Concentrations. Therefore, contamination from the Shell Terminal may be contributing pollutants to the San Francisco Bay and concentrations may affect some benthic species adversely within the local area. Because contaminant levels in the vicinity of the Shell Terminal exceed criteria, any runoff from the pier is considered to have a significant adverse impact (Class II) to water quality.

<u>Mitigation Measures for WQ-9</u>:

WQ-9. Shell shall prepare a Storm Water Pollution Prevention Plan (SWPPP) specifying BMPs to reduce the input of chemicals to the San Francisco Bay from the Shell Terminal. Shell shall coordinate with the RWQCB in developing the SWPPP that Shell shall prepare specifically for the Shell Terminal. BMPs for consideration shall include (at a minimum) (1) conducting all vehicle maintenance on land not over water or marshland, (2) berming all areas on the pier where maintenance activities are being conducted and cleaning up all spilled contaminants before berms are removed, (3) washing the surface of the pier to the extent practical and directing washwater into sumps, (4) maintenance of sumps, and (5) posting signs to educate all workers to the importance of keeping contaminants from entering the San Francisco Bay.

<u>Rationale for Mitigation</u>: No SWPPP presently exists for the Shell Terminal. The requirement to include measures specific to Shell Terminal Operations in the Shell SWPPP and the implementation of those measures will help reduce the input of contaminants into the San Francisco Bay from operations on the Shell Terminal.

Aggressive implementation of BMPs to reduce the input of chemicals to the San Francisco Bay from stormwater runoff would reduce Shell's input of these chemicals to the environment and reduce water quality degradation at the Shell Terminal to adverse, but less than significant.

Impact WQ-10: Maintenance Dredging

The effects of dredging and dredged material disposal on water quality are regulated and subject to acquisition of a dredging permit prior to dredging, thus impacts on water quality are adverse, but less than significant (Class III).

Shell does not need to dredge Berths #1 and #2 because the sediment at those berths is scoured by the strong currents in Carquinez Strait. Sediment deposition does occur at Berths #3 and #4 on the south side of the Shell Terminal. At the present time, those berths are not being used. However, during the life of the lease Shell may choose to dredge Berths #3 and #4 and put them back into operation. The last time dredging was conducted at the Shell Terminal was in 1990 when approximately 47,000 cubic yards of material was dredged from Berths #3 and #4 and discharged at the Carquinez Strait dredged material disposal site (Johnson 2005). Future dredged sediment disposal would be in accordance with the Long Term Management Strategy for Placement of Dredged Material in the San Francisco Bay Region (USACE, USEPA, BCDC, SFBRWQCB 2001).

No data are available on the sediments at Berths #3 and #4. Based on 1995 data on sediments in the vicinity of the Shell Terminal (Tables 4.2-13 through 4.2-15), sediments would be expected to consist of about 65 to 78 percent fines and have elevated levels of some contaminants.

Dredging and disposal of sediments from the Shell Terminal may have an adverse effect on water clarity. The fine sediments may stay in suspension and be transported by the strong currents of Carquinez Straits for a considerable distance. However, turbidity impacts would be limited to the duration of the dredging, which would not be expected to last for more than a few weeks. Monitoring of water column chemicals during dredging projects in San Francisco Bay indicated that contaminant concentrations did not exceed water quality objectives (USACE and Contra Costa County 1997).

Dredged material disposal in San Francisco Bay is regulated by the interagency DMMO. This interagency group evaluates the physical and chemical characteristics of the dredged sediments to make sure that they are compatible for in-water disposal in the San Francisco Bay. Because the effects of dredging and dredged material disposal on water quality are transitory and because sediment composition is evaluated by the DMMO before a dredging permit is issued, the impacts of maintenance dredging at the Shell Terminal on water quality are determined to be adverse, but less than significant (Class III).

<u>WQ-10: No mitigation is required</u>.

Impact WQ-11: Oil and Product Leaks and Spills at the Shell Terminal

Potential impacts on water quality can result from leaks or spills. Small leaks or spills (less than 50 bbl) related to Shell Terminal operations could result in significant (Class II) impacts, while large spills (greater than 50 bbl) could result in significant adverse impacts (Class I).

To accurately assess the impacts of petroleum spills and chronic petroleum discharges to the marine environment, it is necessary to know the make up of the crude oil or product spilled and the physical, chemical, and biological processes that transform petroleum hydrocarbons spilled in the marine environment. Several comprehensive reviews describe the fate and behavior of petroleum introduced into the marine environment (NRC 1985, 2003; Jordan and Payne 1980; Rytkonen, Hirvi, and Hakala 1991).

A wide range of crude oil, feed stocks, additives, and processed petroleum products are transferred through the Shell Terminal between its Refinery and vessels that call at the pier. During the last five years, vessels at the Shell Terminal have received between 7,654,629 and 10,561,853 barrels per year from the Refinery and have delivered between 5,336,836 and 13,821,244 bpy (Table 2.3-1). The Shell Terminal handles a variety of light and heavy petroleum products. Light products handled by the facility include finished gasoline, gasoline components and blend stocks, jet fuels, diesel fuels, and cutter stocks. Heavy products include crude oils, gas oils, residual materials, condensates and other refinery feedstocks.

Crude oils vary widely in appearance and viscosity from field to field. Within the same field, the properties of crude oil vary greatly depending on the season and other environmental factors when the oil was extracted (Chambers Group 1994, NRC 2003). Crude oil and petroleum products are complex substances. Crude oil typically is a mixture of several hundred distinct compounds, most of them hydrocarbons, containing hydrogen and carbon in various proportions. Of the hydrocarbon compounds common in petroleum, PAHs appear to pose the greatest toxicity to the environment (NRC 2003). When crude oil is distilled into petroleum products, it is essentially sorted into fractions by the boiling temperature of these hundreds of compounds. Boiling temperature is strongly correlated with the number of carbon atoms in each molecule. Therefore, some petroleum products have low boiling temperatures and relatively simple molecules with few carbon atoms, while others have higher boiling temperatures, larger molecules, and more carbon atoms per molecule. The higher the boiling temperature is, the greater the density of the resulting product.

Refiners control the mix of hydrocarbon types in particular products in order to give petroleum products distinct properties. Hydrocarbons in the C2-C4 range are all natural gas liquids; hydrocarbons in the C5-C10 range predominate in gasoline; and C12-C20 comprises middle distillates, which are used to make diesel fuel, kerosene, and jet fuel. Larger molecules generally wind up as lubricants, waxes, and residual fuel oil. Each of the hydrocarbons has distinctive characteristics and differs in density, vapor pressure, and solubility. Therefore, the fate of spilled oil in water varies significantly depending on the make up of the oil spilled.

The fate of spilled oil in the marine environment is determined by a variety of complex and interrelated physical, chemical, and biological transformations. The physical and chemical processes involved in the "weathering" process of spilled oil include evaporation, dissolution and vertical mixing, photochemical oxidation, emulsification, and sedimentation. The rate of these weathering processes is influenced by a variety of abiotic factors (e.g., water temperature, suspended particulates, water clarity), physical-chemical properties inherent to the oil itself (e.g., vapor pressure, solubility, aromatic, asphaltene, and wax content), and the relative composition of the hydrocarbon source matrix (e.g., crude oil or refined products). The mass fraction of aromatic present in a crude oil is an important indicator of potential toxicity of a spill, because aromatics are considered the most toxic hydrocarbons in oil (Galt et al. 1991). The asphaltene and wax content determines water-in-oil emulsion formation and is an indicator of how well crude oil will form a stable emulsion or mousse in seawater.

The biological processes involved in the weathering of spilled oil include microbial degradation and uptake of hydrocarbons by larger organisms and its subsequent metabolism. The biodegradation of petroleum by microorganisms is one of the principal mechanisms for removal of petroleum from the marine environment. Enhancement of natural biodegradation processes by microbes may be one of the least ecologically damaging ways of removing oil from the marine environment. Uptake of hydrocarbons by large organisms usually has adverse impacts in the biota because of the toxicity of petroleum hydrocarbons.

Several competing forces occur simultaneously once oil has been released into the marine environment. The processes affecting the fate of spilled oil include: (1) advection (drift) and spreading, (2) evaporation, (3) dissolution, (4) dispersion, (5) emulsification, (6) photo-oxidation/auto-oxidation, and (7) sedimentation. Advection or drift is measured by the movement of the center of mass of an oil slick and is primarily controlled by wind, waves, and surface currents. Spreading of oil on water is probably the most significant process for the first 6 to 10 hours following a spill. Gravitational, inertial, and frictional forces are responsible for spreading oil. As spreading occurs, the volatile fractions of the oil are lost to evaporation or dissolution, leading to an increase in the viscosity and specific gravity of the remaining oil. Depending on the product spilled, the rate of evaporation can be important in determining if impacts occur. Spills of refined products, such as kerosene, gasoline, aviation fuel, and jet fuel, may completely evaporate within 24 hours of the spill. Evaporation can account for up to 50 percent of a crude oil spill being lost during the first 24 to 48 hours. Evaporation depends on the physical properties of the spilled oil and on sea state, intensity of solar radiation, wind velocity, and air and sea temperatures.

Because of the low aqueous solubility of most hydrocarbon components of crude oil, dissolution is less important than evaporation. Salinity, temperature, and turbulence of seawater affect the dissolution rate of each hydrocarbon component. The more soluble petroleum hydrocarbons are those with the greatest aromatic and olefin characteristics. For example, the toxic polynuclear aromatics are more soluble in seawater than the relatively nontoxic, longer chain paraffins.

The movement of small particles, or globules, of oil into the water column (dispersion) is believed to be caused by propulsion of surface turbulence (wind, waves, and ship traffic). Such oil-in-water emulsions are unstable and can be stabilized only by natural or added emulsifiers, detergents, dispersants, or suspended particulates. Generally, an oil spill will begin to disperse immediately, and after 100 hours, dispersion will overtake spreading as the principal mechanism for distributing spilled oil (SAIC 1984).

Emulsification arises from the dispersion of spilled oil and represents a change of state from an oil-in-water dispersion to a water-in-oil emulsion. Crude oils with high asphaltene content or high viscosity form mousse emulsions more than paraffin crude oils (Bocar and Gatellier 1981, cited in NRC 1985). Lighter petroleum distillates, such as gasoline, kerosene, aviation fuel, jet fuel, and diesel fuel oils, do not form mousse (NRC 1985).

Photo-oxidation (the action of sunlight in the presence of oxygen) is a long-term weathering process, which can degrade toxic components in petroleum. For example, potential carcinogens such as benzo[a]pyrene have been shown to be photo-oxidized by sunlight. Oil that evaporates is photochemically oxidized in the atmosphere. In surface water, photo-oxidation may be important on a time scale of minutes to days.

Sedimentation and sinking of spilled oil is caused by sorption of particulates and ingestion of hydrocarbons by zooplankton. Weathering processes increase the density of oil, which leads to incorporation of particulates and the agglomeration of oil-particulate mixtures that eventually sink. In general, extensive weathering is required before the oil residual has a specific gravity greater than that of seawater. Some weathering and fractionation of oil appears to be necessary before incorporation into suspended material. Test tank studies have shown that fractionation of oil is common before it is incorporated into suspended particulate material.

A significant impact to marine water quality (Class I or II impact) would result from changes in water chemistry from an accidental spill of crude oil or oil product at the Shell Terminal. Spill probabilities are presented in Section 4.1, Operational Safety/Risk of Accidents. Shell Terminal's operations at the site have the greatest potential for small spills (less than 50 bbl). The containment and cleanup capability at the Shell Terminal is detailed in Section 4.1, Operational Safety/Risk of Accidents.

Physical properties affected by an oil spill include reduced wind stress and thus reduced water surface mixing which limits the exchange of dissolved oxygen between the water and the atmosphere, reduced light transmissivity, and reduced solar warming of the sea surface. The total sea surface area affected by a spill depends on the volume of oil released and the prevailing meteorological conditions, particularly winds.

Most small leaks or spills (less than 50 bbl) related to operations at the Shell Terminal could result in significant, adverse (Class II) impacts that can be mitigated to less than significant, because they could be easily contained. However, the severity of impact from larger leaks or spills (greater than 50 bbl) at the Shell Terminal depends on (1) spill size, (2) oil composition, (3) spill characteristics (instantaneous vs. prolonged discharge), (4) the effect of environmental conditions on spill properties due to weathering, and (5) the effectiveness of cleanup operations. In the event of an oil spill, the initial impacts would be to the quality of surface waters and the water column, followed by potential impacts to sedimentary and shoreline environments. Following an oil spill, hydrocarbon fractions would be partitioned into different regimes and each fraction would have a potential impact on water quality. Large spills (greater than 50 bbl) at the Shell Terminal could result in significant adverse impacts (Class I) on water quality.

The duration of potential impacts to water quality is variable and depends on the type of oil spilled. The most toxic period for crude oil spilled is the first few days due to volatile, low molecular weight hydrocarbons (BLM 1980). Product spills of gasoline and fuels may evaporate faster than crude oil, but are generally more toxic and more soluble. Toxicity tests performed on oil by the EPA have shown that aromatic constituents are the most toxic, naphthenes and olefins are intermediate in toxicity, and straight chain paraffins are the least toxic (Chambers Group 1988).

Mitigation Measures for WQ-11:

WQ-11. MM OS-3a through OS-3c and OS-4 (Operational Safety/Risk of Upset) shall be implemented.

Rationale for Mitigation: These measures provide greater safety in preventing spills and improving response capability and help to reduce impacts to water quality to the maximum extent feasible. The measures would lower the probability of an oil spill by allowing for quick release of mooring lines (OS-3a), monitoring of tension of the mooring lines (OS-3b), allision avoidance (OS-3c), and ensuring through implementation of new technologies for safety upgrades that Shell Terminal components are in proper operating condition (OS-3d). These measures help to reduce the potential for spills and their associated impacts.

Residual Impacts: Large spills at the Shell Terminal (greater than 50 bbls) may result in significant adverse impacts (Class I) on water quality.

4.2.4.2 Oil Spills From Vessels in Transit in Bay or Along Outer Coast

Impact WQ-12: Water Quality Impacts from Accidental Spills from Vessels in Transit in Bay or Along Outer Coast

A significant impact to water quality (Class I or II) could result from leaks or an accidental spill of crude oil or oil product from a vessel spill along tanker routes either in San Francisco Bay or outer coast waters.

The fate and water quality impacts of oil from a spill associated with vessels servicing the Shell Terminal would be similar to the impacts described above for the proposed Project at the terminal. A significant impact to water quality (Class I or II) would result from an accidental spill of crude oil or oil product from a vessel transiting San Francisco Bay or outer coast waters. A larger oil spill is more likely from accidents associated with vessels in transit than a spill at the Shell Terminal. Most tanker spills/accidents and larger spills that cannot be quickly contained either in the San Francisco Bay or along the outer coast would result in significant, adverse impacts (Class I).

<u>Mitigation Measures for WQ-12</u>:

WQ-12. Shell shall implement MM OS-7a and OS-7b of Section 4.1, Operational Safety/Risk of Upset, addressing potential participation in VTS upgrade evaluations, and Shell response actions for spills at or near the Shell Terminal.

<u>Rationale for Mitigation</u>: Response capability for containment and cleanup of vessel spills while transiting the San Francisco Bay or outer coast is not Shell's responsibility. Nevertheless, as a participant in any analysis to examine upgrades to the VTS (OS-7a), Shell can help to improve transit issues and response capabilities in general, which help to reduce the consequences of spills within the San Francisco Bay. For a spill near the Shell Terminal, Shell is more suited to provide immediate response (OS-7b) to a spill using its own equipment and resources, rather than waiting for mobilization and arrival of the vessel's response organization. The Shell Terminal staff is fully trained to take immediate actions in response to spills. Such action will result in a quicker application of oil spill equipment to any spill and improve control and recovery of such spill.

<u>Residual Impacts</u>: Even with these measures, the residual impacts to water quality may remain significant (Class I).

4.2.5 Impacts of Alternatives

Impact WQ-13: No Project Alternative

The alternative would eliminate the water quality impacts associated with operations at the Shell Terminal resulting in a beneficial (Class IV) impact. Water quality impacts (Class I, II and III) would be transferred to other marine terminals and would be similar to the proposed Project. Shell has no responsibility for these other terminals. Decommissioning and removal of the Shell Terminal wharf might result in temporary, adverse, but less than significant impacts on water quality (Class III).

Under the No Project Alternative, Shell's lease would not be renewed and the existing Shell Terminal would be subsequently decommissioned with its components abandoned in place, removed, or a combination thereof. The decommissioning of the Shell Terminal would follow an Abandonment and Restoration Plan as described in Section 3.3.1, No Project Alternative.

Under the No Project Alternative, alternative means of crude oil/product transportation would need to be in place prior to decommissioning of the Shell Terminal, or the operation of the Shell Refinery would cease production, at least temporarily. It is more likely, however, that under the No Project Alternative, Shell would pursue alternative means of traditional crude oil transportation, such as a pipeline transportation, or use of a different marine terminal. Accordingly, this Draft EIR describes and analyzes the potential environmental impacts of these alternatives. For the purposes of this Draft EIR, it has been assumed that the No Project Alternative would result in a decommissioning schedule that would consider implementation of one of the described transportation alternatives. Any future crude oil or product transportation alternative would be the subject of a subsequent application to the CSLC and other agencies having jurisdiction, depending on the proposed alternative.

During decommissioning, impacts would be similar to the proposed Project with the potential for small spills associated with pipeline drainage, pipeline and pier removal. If the Shell Terminal pier is removed, temporary impacts to water quality would occur by the disturbance of sediments during pier removal. These impacts would be short lived and are considered adverse but less than significant (Class III).

Following decommissioning, the No Project Alternative would eliminate the water quality impacts associated with operations at the Shell Terminal. The transfer of tanker traffic from the Shell Terminal to another marine terminal would eliminate inputs of contaminants from runoff from the Shell Terminal, as well as some of the small leaks and spills that enter the water directly from terminal operations. In addition, the No Project Alternative would eliminate any temporary water quality impacts associated with maintenance dredging to restore adequate depth at Berths #3 and #4. Because the additional tanker traffic at another marine terminal would not be expected to increase significantly the quantity of contaminants in stormwater runoff from the other terminal or needed maintenance dredging, this alternative would have fewer impacts to water quality than continued operations at the Shell Terminal.

Water quality impacts associated with vessels would be transferred to another marine terminal and would be similar to the proposed Project. These impacts include turbidity generated by boat propellers and bow thrusters, introduction of exotic organisms in ballast water discharges, discharge of heated cooling water, introduction of toxins used as anti-fouling agents on tankers, and introduction of metals from cathodic protection on vessels. These potential impacts of spills on water quality would remain similar to the proposed Project, but would be transferred to another marine terminal.

<u>WQ-13: No mitigation is required</u>.

Impact WQ-14: Full Throughput Alternative

This alternative would eliminate the water quality impacts associated with operations at the Shell Terminal resulting in a beneficial (Class IV) impact. Water quality impacts (Class I, II and III) would be transferred to other Bay Area terminals and would be similar to the proposed Project. A pipeline spill or substantial leak that would reach a water body could result in a significant (Class I or II) impact to water quality, depending on whether the spill could be easily contained.

The transfer of tanker traffic from the Shell Terminal to other Bay Area terminals would eliminate water quality impacts at the Shell Terminal at Martinez. Elimination of these impacts would have a beneficial (Class IV) impact at the Shell Martinez site. However, the other terminals' increased activity could result in similar impacts to water quality as compared to the proposed Project. These impacts include sediment disturbance from vessel maneuvers (Class III), discharge of segregated ballast water (Class I), treatment and discharge of segregated ballast water at a wastewater treatment facility (Class II), discharge of cooling water (Class III), degradation of water quality from transfer of vessel wastes, vessel maintenance or run-off from the pier (Class II), leaching of metals from cathodic protection (Class III), input of toxins from anti-fouling paints (Class I), temporary increases in suspended sediment from maintenance dredging (Class III), and oil and product leaks and spills (Class I or II). These potential impacts of spills on water quality would remain similar to the proposed Project, but would be transferred to other marine terminals.

A combination of new and existing pipelines would be needed to transport oil and products to and from the Shell Refinery to the other terminals. A pipeline spill or substantial leak that would reach a water body could result in a significant (Class I or II) impact to water quality, depending on whether the spill could be easily contained.

<u>Mitigation Measures for WQ-14</u>: Shell shall implement proposed Project MM WQ-2, WQ-4, WQ-5, WQ-7, OS-3a through OS-3d, OS-7a, and OS-7b, and MM GEO-8.

Rationale for Mitigation: These measures would provide protection against spills to the extent feasible by applying additional safety measures to the wharf. MM GEO-8 measures are standard practice for on-land spill cleanup and may have specific provisions that vary by geographical area to respond to specific resources.

Residual Impacts: Significant adverse water quality impacts (Class I) could occur if significant amounts of oil reached a water body.

4.2.6 Cumulative Projects Impacts Analysis

Impact CUM-WQ-1: Contaminants Impacts on San Francisco Bay Water Quality

The water quality of the San Francisco Bay estuary has been degraded by inputs of pollutants from a variety of sources, as such, any contribution of a contaminant already at significantly high levels to the waters of San Francisco Bay would have a significant adverse impact at the cumulative level (Class I).

The water quality of the San Francisco Bay estuary has been degraded by inputs of pollutants from a variety of sources. Major sources of contaminants include municipal wastewater and industrial discharges and a variety of nonpoint sources such as urban and agricultural run-off; riverine inputs; dredging and dredge material disposal; marine vessel inputs; and inputs from air pollutants, spills, and accidents. In general, stormwater run-off is responsible for the greatest mass loadings of most contaminants (Davis et al. 2000). The sources of contaminants to the San Francisco Bay estuary and the levels of contaminants throughout the estuary are discussed in detail in Section 4.2.1, Environmental Setting. That section describes levels of many contaminants in the water column, in the sediments, and in the biota in the estuary that either exceed water quality objectives in the San Francisco Bay Basin Plan or are at levels known to have harmful effects on aquatic organisms. Table 4.2-16 lists contaminants of particular concern in the San Francisco estuary. Table 4.2-7, in Section 4.2.1, Environmental Setting, lists contaminants that are considered to have impaired water quality in Carquinez Strait and Suisun Bay. Any contribution of a contaminant already at significantly high levels to the waters of San Francisco Bay would have a significant adverse impact at the cumulative level (Class I). Any contribution of these contaminants from Shell Terminal operations would be a significant adverse cumulative impact (Class I). Of the contaminants listed as significantly elevated in Tables 4.2-7 and 4.2-16, operations at the Shell Terminal would not contribute to pesticides or PCBs.

Table 4.2-16
Pollutants of Particular Concern in the Bay/Delta Estuary

Trace Elements	
Cadmium (Cd) Copper (Cu) Mercury (Hg) Nickel (Ni)	Selenium (Se) Silver (Ag) Tin (Tributyl)
Organochlorines and Other Pesticides	
Chlordane and its metabolites DDT and its metabolites	Polychlorinated biphenyls Toxaphene
Petroleum Hydrocarbons	
Polynuclear Aromatic Hydrocarbons (PAHs)	
Acenaphthene Acenaphthylene Anthracene Benz(b)fluoranthene Benz(k)fluoranthene Benz(g, h, i)perylene Benzo(a)pyrene Benzo(e)pyrene Benzo(a)anthracene Benzthiazole Chrysene Dibenzo(a, h)anthracene	2, 6-Dimethylnaphthalene Fluoranthene Fluorene 1-Methylnaphthalene 2-Methylnaphthalene 1-Methylphenanthrene 2-(4-morpholinyl)benzthiazole Naphthalene Phenanthrene Pyrene 2, 3, 5-Trimethylphenanthrene Indeno(1, 2, 3-c,d)pyrene
Source: Monroe and Kelly 1992.	

As discussed in Impact WQ-5 for the proposed Project, tankers visiting the Shell Terminal may have contributed to water contamination through use of anti-fouling paints. Anti-fouling paints are biocides that contain copper, sodium, zinc and TBT which are highly toxic. As TBT is gradually phased out by 2008, the Shell Terminal's contribution to TBT in the Project area will decrease. Because organotins are so toxic to marine organisms, any continued use of organotins by vessels in San Francisco Bay is a significant adverse cumulative impact (Class I). Terminal-bound vessels contribute proportionately to this impact.

Operations at the Shell Terminal would contribute other chemical contaminants including small quantities of metals and PAHs. Inputs from the terminal include segregated ballast waters, small leaks and spills of oil and product, some contaminants in vessel paint or sacrificial anodes, and cooling water. None of these inputs have been quantified, but such volumes of contaminant inputs associated with Shell Terminal operations would be expected to be small compared to other sources in San Francisco Bay. The San Francisco Bay's largest municipal discharger, the San Jose/Santa Clara Water Treatment Plant (WTP) located in the South Bay, discharges 133 mgd of treated municipal sewage. Furthermore, inputs from nonpoint sources, including the San Joaquin and Sacramento Rivers and urban run-off, far exceed the permitted point source discharges, especially in wet years. There are indications of elevated concentrations of PAHs in the vicinity of the Shell Terminal (4.2-15) indicating Shell operations either at the Refinery or at the Shell Terminal may have been responsible for increasing local concentrations of PAH compounds.

Contaminants in stormwater run-off from the Shell Terminal pier are unknown. Because of the small area of the pier as compared to the watersheds that contribute runoff to the San Francisco Bay, the total stormwater emissions from the Shell Terminal would be expected to be extremely small compared to the total emissions in all stormwater runoff to the San Francisco Bay.

Similarly, the amount of petroleum contributed to San Francisco Bay waters from chronic releases at the terminal is generally small. As discussed in Operational Safety/Risk of Accidents, Section 4.1.1, Environmental Setting, there have only been three spills of over 1 barrel at the Shell Terminal since 1984.

Continued operations at Shell Terminal would contribute to the cumulative water quality impacts associated with all marine terminals. These impacts include the risk of oil spills and contaminants associated with large vessels including the significant adverse impacts of TBT and exotic organisms in segregated ballast water discharges. Other facilities such as ports that receive visits by tankers also would contribute to the significant adverse impacts of TBT and exotic organisms in ballast water discharges (Class I impacts).

Projects that would involve large vessels such as the ferry project would increase inputs associated with vessels. However, because ferries would not take on ballast in other ports they would not increase the release of exotic organisms in ballast water. In addition, ferries would be new and would not have TBT anti-fouling paint on their hulls. Therefore, ferries would not contribute to cumulative water quality impacts of TBT. The addition of large vessels to San Francisco Bay may slightly raise the risk of an oil spill from collision of a tanker with a ferry.

Projects that involve in-Bay construction such as the I-680 new bridge and retrofit project, and channel deepening projects could temporarily degrade water quality in the Project area by disturbing sediments during pier installation and dredging, and spills and leaks of contaminants into San Francisco Bay waters from various construction activities. Any degradation of water quality during construction would be temporary. In the long run, channel deepening projects might improve water quality by reducing the risk of vessel accidents and reducing the re-suspension of sediments from boat propellers.

Projects that involve development in undeveloped upland areas would add to the cumulative impacts of pollutants in urban run-off. Urban run-off is one of the most significant contributors of pollutants to San Francisco Bay.

Finally, several programs are in place to improve water quality in San Francisco Bay. The LTMS recently was implemented to regulate the discharge of dredged material in the San Francisco Bay. The CALFED Bay Delta Program is seeking to improve conditions in the Bay and Delta. The RWQCB is developing TMDLs for pollutants impairing San Francisco Bay. These programs will have a cumulative beneficial impact on water quality in the Project area.

In summary, operation of the Shell Terminal would contribute to the significant adverse cumulative levels of certain contaminants in the San Francisco Bay estuary. However, this contribution is extremely small compared to other sources, particularly runoff and municipal discharges.

Mitigation Measures for CUM-WQ-1:

CUM-WQ-1. Shell shall implement proposed Project measures WQ-4, WQ-5, and WQ-7.

Rationale for mitigation: Shell's implementation of measures to decrease spill risk and increase response capability, combined with preparation of measures specific to the Shell Terminal in its SWPPP would help the terminal reduce its contribution of contaminants into the water. In the long-term, documentation of vessels using TBT or other metal-based anti-fouling paints would help to reduce water quality impacts.

Although Shell may reduce its Shell Terminal's contribution of pollutants to San Francisco Bay to less than significant, the cumulative impact of degraded water quality, especially from urban run-off, is expected to remain significant (Class I). The development of Total Maximum Daily Loads for priority pollutants by the RWQCB and the implementation of Bay-wide management practices to meet those loads will help to reduce cumulative significant adverse water quality impacts.

Residual Impacts: Until the mandate prohibiting TBT use on ship hulls comes into effect in 2008, impacts of anti-fouling paints will remain significant (Class I).

Impact CUM-WQ-2: Segregated Ballast Water

Contribution of contaminants or exotic organisms from operations at the Shell Terminal would be a significant adverse cumulative impact that cannot be mitigated to less than significant (Class I).

The discharge of segregated ballast water from vessels visiting the Shell Terminal would contribute to the significant cumulative adverse impacts to water quality and biological resources from the introduction of toxic microorganisms and invasive macroorganisms to San Francisco Bay. No information is available on the volume of segregated ballast water discharged annually to San Francisco Bay by vessels associated with the Shell Terminal. Table 4.2-17 shows the amounts of ballast water discharged by tank vessels operating in San Francisco Bay per year.

Table 4.2-17
Amounts of Ballast Water Discharged
by Tank Vessels Operating in San Francisco Bay Per Year

Year	Amount Reported (metric tons)
2000	577,627
2001	958,846
2002	905,173
2003	518,058
2004	1,521,812
2005*	2,114,790

*** amounts through 12/15/05 Note: Between 2000 and 2003 the law exempted TAPS trade tankers (U.S. Flagged, U.S. Crewed tank vessels, carrying petroleum from one U.S. port to another U.S. port) and only required reporting on ballast water discharges at first port of call.**

Source: M.Falkner, California State Lands Commission, personal communication 2005.

Because many of these non-indigenous organisms in ballast water are so invasive even a small volume of discharge can have devastating effects that are not proportional to relative discharge volumes. Moreover, non-indigenous organisms may remain in ballast water that has been exchanged in the mid-ocean. The impacts of invasive species are discussed in detail in Section 4.3, Biological Resources.

Mitigation Measures for CUM-WQ-2:

CUM-WQ-2. Implement MM WQ-2.

Rationale for mitigation: Adherence to this measure addresses procedures for ballast water management Shell must follow for tracking the compliance of the vessels visiting its Shell Terminal. The measure is a tracking measure only, and does not reduce the level of impact, as the problem is a regional/San Francisco Bay-wide problem.

Residual Impacts: Until a feasible system is developed kill organisms in ballast water, the discharge of ballast water to the San Francisco Bay will remain significant (Class I).

Impact CUM-WQ-3: Oil Spills along Outer Coast

A major oil spill along the outer coast would have a significant adverse (Class I) cumulative impact on water quality. A spill along the outer coast would not be within Shell's responsibility.

Contaminant levels on the outer coast generally do not exceed water quality objectives. Shell Terminal tankering would not have a significant adverse impact on water quality on the outer coast, except in the event of a major oil spill. Section 4.1, Operational

Safety/Risk of Accidents presents a discussion of cumulative oil spill risk. A major oil spill would have a significant adverse (Class I), cumulative effect on water quality.

Mitigation Measures for CUM-WQ-3:

CUM-WQ-3. Implement MM OS-7a.

Rationale for mitigation: The measure calls for Shell to participate in VTS upgrade evaluations as opportunities arise. Such participation may help to evaluate and guide improvements in the VTS system.

Residual Impacts: Impacts of large spills would remain significant (Class I).

Table 4.2-18
Summary of Water Quality Impacts and Mitigation Measures

Impact	Mitigation Measures
WQ-1: Sediment Disturbance to Water Quality from Vessel Maneuvers	**WQ-1:** No mitigation required.
WQ-2: Segregated Ballast Water	**WQ-2:** Shell will advise shipping company agents and representatives planning to have vessels call at the Shell Terminal about the California Marine Invasive Species Act; and ensure that vessel operators fill out required questionnaire.
WQ-3: Cooling Water	**WQ-3:** No mitigation required.
WQ-4: Non-Segregated Ballast Water	**WQ-4:** No discharge to San Francisco Bay; transport via tanker truck/other waste handling vehicle to appropriate facility.
WQ-5: Other Liquid Wastes	**WQ-5:** Prepare Spill Prevention Plan for Terminal to include Best Management Practices.
WQ-6: Cathodic Protection	**WQ-6:** No mitigation required.
WQ-7: Anti-Fouling Paints	**WQ-7:** Shell will advise agents and representatives of shipping companies planning to have vessels call at the Shell Terminal about the requirements of the 2008 IMO prohibition of TBT applications to vessel hulls.
WQ-8: Tanker Maintenance	**WQ-8:** Apply WQ-5 for preparation of a Spill Prevention Plan.
WQ-9: Stormwater Runoff from Shell Terminal	**WQ-9:** Shell shall coordinate with the Regional Water Quality Control Board in developing a Stormwater Pollution Prevention Plan that Shell shall prepare specifically for the Shell Terminal.
WQ-10: Maintenance Dredging	**WQ-10:** No mitigation required.
WQ-11: Oil and Product Leaks and Spills	**WQ-11:** Implement MM OS-3a through OS-3c and MM OS-4.
WQ-12: Water Quality from Accidental Spills	**WQ-12:** Implement MM OS-7a and MM OS-7b.
WQ-13: No Project Alternative	**WQ-13:** No mitigation is required.
WQ-14: Full Throughput Alternative	**WQ-14:** Implement MM WQ-2, WQ-4, WQ-5, WQ-7, OS-3a-c, OS-7a-b, and GEO-8.
CUM-WQ-1: Contaminants on San Francisco Bay and Outer Coast	**CUM-WQ-1a:** Implement MM WQ-4, WQ-5, and WQ-7a.
CUM-WQ-2: Segregated Ballast Water	**CUM-WQ-2:** Implement MM WQ-2.
CUM-WQ-3: Oil Spills along Outer Coast	**CUM-WQ-3:** Implement MM OS-7a.

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